

# Final Summary of Research

## Space Life Sciences Research and Education Program

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Since 1969, the Universities Space Research Association (USRA), a private, nonprofit corporation, has worked closely with the National Aeronautics and Space Administration (NASA) to advance space science and technology and to promote education in those areas. USRA's Division of Space Life Sciences (DSLS) has been NASA's life sciences research partner for the past 18 years. For the last six years, our Cooperative Agreement NCC9-41 for the "Space Life Sciences Research and Education Program" has stimulated and assisted life sciences research and education at NASA's Johnson Space Center (JSC) – both at the Center and in collaboration with outside academic institutions. To accomplish our objectives, the DSLS has facilitated extramural research, developed and managed educational programs, recruited and employed visiting and staff scientists, and managed scientific meetings.

### **Extramural Research**

Extramural research is an important component of NASA's activities. Our well-established routes of access to the academic community have allowed us to provide for the participation of visiting scientists, consultants, and laboratories with the resources and expertise required to perform the extramural research activities that meet NASA's objectives.

The following tasks, categorized by discipline, summarize the research that was performed by extramural researchers, who served as consultants or worked under subcontracts, during the period of performance.

A complete list of DSLS consultants appears in Appendix I; a complete list of DSLS subcontracts is depicted in Appendix II.

#### **Bioethics, Dr. Baruch Brody, Consultant (10/01/95 – 09/30-01)**

- conducted a series of meetings with international partners to develop a basis for an international agreement on the medical tests to be used for determining medical fitness for space flight. (1995 and 1996)
- with his working group completed a final report on potential conflicts of interest that current or future investigators who may have financial interests related to the commercial development of the results of the research may encounter. (1997)
- assembled a Task Force on Ethical Issues Related to Research in Environmental and Habitation Issues. (1998)
- with his working group completed final reports on ethical issues related to purchase of research time from the Russians on the International Space Station and issues concerning selection and de-selection of astronauts as research subjects and concerning release of medical and research data. (1999)
- convened a group of bioethicists to discuss ethical issues in human-machine symbiosis technologies; the committee identified issues that it urged NASA to study further. He also chaired the NASA Bioethics Task Force that reviewed and responded to questions from the National Bioethics Advisory Commission about the Common Rule as it applies to NASA research. (2000)

- convened a group of scientists and bioethicists to serve as the NASA “Data Safety and Monitoring Board (DSMB)” to review the NASA Prebreathe Reduction Protocol and Related Research. (2001)

**Biomechanics, Dr. Charles Layne, Consultant (08/01/97 – 09/30/00)**

- performed preliminary processing of the neuromuscular activation data obtained during long-duration flight and analyzed neuromuscular characteristics performed on the PABF

**Biomechanics, Dr. Vernon McDonald, Consultant (10/01/96 – 09/30/97)**

- developed perceptual-motor strategies for achieving optimum EVA task performance and maintaining spatial orientation by utilizing ground-based studies in the weightless environment training facility (WETF) and on the precision air bearing floor (PABF) to develop a conceptual model.

**Biomechanics, Dr. Kim Prisk, Principal Investigator (10/01/99 – 12/31/99)**

- provided scientific oversight for the development of a prototype user interface for the ISS Human Research Facility Pulmonary Function System (PFS). This work was performed under a subcontract with the University of California San Diego, which delivered software and documentation to PFS developer INNOVISION.

**Biomechanics, Dr. Richard E. A. Van Emmerick, Consultant (06/01/96 – 08/31/96)**

- validated simulator data to complement investigations of postural and manual control during EVA

**Biotechnology, Ms. Kimberly Herrick, Consultant (06/26/00 – 09/30/01)**

- performed bibliographic research, editing and formatting of research manuscripts for publication in national science journals.

**Bone and Muscle Physiology, Dr. John Hoyer, HRF Visiting Scientist (10/01/95 – 12/31/95)**

- completed studies of on-orbit renal stone formation. This work was performed under a subcontract with the Children’s Hospital of Philadelphia.

**Bone and Muscle Physiology, Dr. J. Lawrence Katz, HRF Visiting Scientist (12/01/95 – 12/31/96)**

- used clinical acoustical techniques to monitor “bone mineral quality” by establishing a relationship between bone mineral quality and the velocity and/or attenuation of ultrasonic waves through the calcaneus.
- measured elastic properties of trabecular bone with a scanning acoustic microscope to correlate those measurements with measurements made with clinically available acoustic devices. This work was performed under a subcontract with Case Western Reserve University.

**Data Management, Dr. Ron Croston, Principal Investigator  
(10/01/95 – 11/30/96)**

- designed and implemented a relational database to integrate and analyze all science payloads for the NASA Mir program.
- assembled a computer laboratory facility for the Payload Integration and Planning System.

**Database Integration, Dr. David R. Pendergast, Principal Investigator  
(10/01/96 – 09/30/97)**

- prepared, validated, and compiled data tables for the SLS-2 EO66 experiment for the Life Sciences Data Archive, performed under a subcontract with the State University of New York Buffalo.

**Environmental Health, Dr. Donal Day, Principal Investigator (03/01/98 – 09/30/98)**

- developed a rapid static assay to measure bacterial deposition and removal and an image analysis method to allow real time monitoring of bacterial deposition and removal. This work was performed under a subcontract with the Audubon Sugar Institute of Louisiana State University's Agricultural Experiment Station.

**Environmental Health, Dr. Andrea Dietrich, HRF Visiting Scientist  
(01/01/96 – 02/15/97)**

- evaluated a quick and inexpensive method of detecting iodinated disinfection by-products in Space Shuttle drinking water by combining chemical analysis with a quantification of taste assessment. This work was performed under a subcontract to Virginia Polytechnic Institute.

**Environmental Health, Mr. James Waligora, Consultant (08/09/00 – 09/30/01)**

- served as a subject matter expert for physiological and operational constraints involving decompression sickness protection.
- served on the Medical Operations EVA IPT for the Shuttle Transportation System and the Prebreathe Reduction Program for the International Space Station.

**Exercise Physiology, Dr. Mark Sothmann, Principal Investigator  
(01/15/96 – 09/30/96)**

- used gas exchange data and a biomechanical analysis of movement patterns to determine the consequences of weightlessness and the launch and entry suit effects on mechanical efficiency and physiological responses. This work was performed under a subcontract with Indiana University.

**Exercise Physiology, Dr. Jack Wilmore, Principal Investigator (01/15/96 – 06/30/97)**

- evaluated three different types of exercise countermeasures performed during space flight for their effectiveness in the maintenance of preflight levels of cardiorespiratory response to exercise. This work was performed under a subcontract with the University of Texas at Austin.

**Medical Operations, Dr. Richard McCluskey, Consultant (06/15/98 – 09/30/98)**

- observed hyperbaric and hypobaric activities in the Neutral Buoyancy Laboratory as a medical monitor in addition to developing a plan for certain operational medical scenarios and preparing experimental procedures for landings on the Moon and Mars.

**Microbiology, Consultant Dr. Henry Isenberg (08/01/98 – 09/30/00)**

- analyzed microbiological samples from space shuttle crewmembers before and after space flight to determine if changes in the normal microbiota during space flight can be correlated with the variations observed in terrestrial populations during normal and stressful conditions

**Microbiology, Dr. Saroj Mishra Visiting Scientist (01/20/98 – 10/31/99) and Consultant (03/20/00 – 09/30/00)**

- analyzed pre- and postflight microbiology data from 49 STS crew members to assess the frequency of occurrence of microbial taxa. He also performed a literature search and prepared a rough draft of a manuscript, encompassing the data, on biological changes that could be attributable to short duration space missions.
- completed data analysis for studies on a state-of-the-art tight building with a computer controlled climate control system that is an analog for the study of the dynamics of microbial load in a nearly closed environmental system. He also analyzed clinical and environmental data collected from Space Shuttle and NASA-Mir missions. In 1999 Dr. Mishra received a certificate and cash award for his invention "Neutrophil Screening Assay Using Two Color Flow Cytometry."

**Microbiology, Dr. Cheryl Nickerson, Principal Investigator (02/01/99 – 09/30/99)**

- demonstrated the effect of simulated microgravity on the virulence of the enteric pathogen *Salmonella typhimurium*.
- used a novel cDNA enrichment strategy to identify *S. typhimurium* sequences transcribed during growth under conditions of simulated microgravity versus normal gravity. This work was performed under a subcontract with Tulane University Medical Center.

**Microbiology, Dr. Barry Pyle, Principal Investigator (03/01/99 – 05/31/00)**

- performed experiments to determine the effectiveness of lower levels of iodine in controlling bacterial levels in the Space Shuttle and International Space Station water systems.
- recommended the continuation of disinfection experiments after studying the results of disinfection utilizing low iodine concentrations. This work was performed under a subcontract with Montana State University.

**Microbiology, Dr. John Schreiber, Principal Investigator (10/01/95 – 01/01/96)**

- completed study of gram negative bacteria. This work was performed under a subcontract with Case Western Reserve University.

**Neuroscience, Dr. Edward Hillman, Principal Investigator (01/01/96 – 06/30/96)**

- created a test of Dynamic Visual Acuity while walking that objectively measures a subject's degree of oscillopsia. This test has implications both for labyrinthine-deficient patients and astronauts returning from space flight. The task was performed under a subcontract with Baylor College of Medicine.

**Neuroscience, Dr. Ralph Jell, Principal Investigator (01/01/96 – 09/30/96)**

- studied visual stimulation during rotation using an optokinetic stimulator. This work was performed under a subcontract with the University of Manitoba.

**Neuroscience, Dr. Sylviane Kahane, Consultant (01/02/96 – 09/30/96)**

- used infrared video techniques to collect and record the responses of head and eye movements to stimulated the otoliths, semicircular canals, and neck proprioceptors.

**Neuroscience, Dr. Lars Oddsson, Principal Investigator (07/01/01 – 09/30/01)**

- initiated the design and development of a portable balance platform named "BALDERINI," which can perform a subset of the repertoire of the BALDER platform, a unique balance perturbation platform located in the NeuroMuscular Research Center (NMRC) of Boston University. This work was performed under a subcontract with Boston University.

**Nutritional Biochemistry, Dr. Gladys Block, Principal Investigator (06/15/96 – 09/30/01)**

- developed a very brief dietary assessment tool to provide real-time on-orbit evaluation of the adequacy of intake of crucial nutrients and dietary components.
- refined her Food Frequency Questionnaire and its ability to calculate nutrient intake after it was tested during a 60- and 80-day chamber tests in 1997 and 1999.
- analyzed data from the U.S. and Russian food systems and updated the food frequency questionnaire as needed for use on orbit for real-time assessment of crew nutrient intake.
- provided expertise and data analysis for updating and validating the space flight food frequency questionnaire for use on International Space Station missions.

**Nutritional Biochemistry, Dr. Kimberly O'Brien, Principal Investigator (11/01/96 - 09/30/99)**

- designed calcium kinetic studies, including techniques for the use of saliva isotopic measurements, to address calcium absorption and bone calcium turnover in microgravity. A goal of this study was to determine whether saliva sampling can be used as a simple, noninvasive measure of calcium kinetics as an alternative to inflight blood sampling. This work was performed under a subcontract to Johns Hopkins University. (1997)
- established dosing and sample collection requirements and the sample processing techniques. (1998)

- analyzed samples and consulted about protocol design and sample collection for calcium kinetic studies that address calcium absorption and bone calcium turnover during weightlessness. (1999)

**Nutritional Biochemistry, Dr. Meryl Wastney, Principal Investigator  
(1/12/9 – 09/30/98) (01/01/01 – 9/30/01)**

- developed procedures and protocols for optimum dose/sampling designs, and provided interpretation of the associated ground and flight studies. This work was performed under a subcontract with Georgetown University. (1997)
- analyzed calcium tracer data from the three subjects who were studied before, during, and following 115 days on Mir. (1998)
- participated in the planning of a possible future study utilizing data obtained from subjects on the Shuttle. (1998)
- participated in planning for calcium kinetic experiments to fly onboard STS-107 and those already flown on NASA-Mir missions. (2001)
- fit the model to data collected pre-flight, in-flight, and post-flight from each subject, optimized the parameter values, and calculated rates of calcium absorption, bone deposition, calcium distribution, excretion, and pool sizes. She used the results to determine the extent of changes in calcium metabolism during space flight and rates of recovery post-flight. (2001)

**Occupational Health and Test Support, Gary Caylor, Consultant  
(08/09/99 – 06/30/01)**

- developed occupational health program process and procedure documents, served as a representative of the Occupational Health Office at safety and health forums, committees, and readiness reviews, conducted technical evaluations of contractor reports and recommendations, and supported other JSC organizations on the development of processes and procedures to reduce or eliminate employee exposures to potential health hazards.
- reviewed and commented on JSC policies concerning Ergonomics, Injury/Illness Case Management, Safety Evaluation, Safety Coordination, narcotics and drugs, Emergency Action Review Plan, Health Services for International Travel or Assignment, Emergency Operations Center medical dispatching, and potential workplace safety and health issues.

**Program Management, Consultant Dr. Lauren Leveton (1/14/96 – 09/30/01)**

- worked with NASA management, investigators, Integrated Product Teams, and discipline leaders to analyze NASA Life Sciences research programs, publications, and data collection activities to develop a critical path strategy for future research. She mapped the critical path strategy with strategies proposed in a report issued by the National Academy of Sciences Committee on Space Biology and Medicine.
- developed presentation materials, test instruments, and web site content, facilitated workshops and meetings, reviewed flight experiments, and prepared and revised the CPR charter, documents, and reports.



- developed, reviewed, and assessed DCS risk mitigation strategies, presentation materials, and NSBRI, BR&C, and AHST program task mapping to the CPR.

**Space Radiation Health, Dr. Leo T. Chylack, Jr., Principal Investigator (05/01/01 – 06/30/01)**

- developed a new optometric protocol to provide better assessment of the lens opacities of astronauts as a result of their exposure to radiation during space flight. The new protocol, which required training and certification of NASA optometrists, added a different acuity measure and an imaging methodology to the current protocol. This work was performed under a subcontract with Brigham & Women's Hospital.

**Space Radiation Health, Robert Richmond, Consultant (07/15/99 – 01/31/01)**

- completed the design for a Crew Active Dosimeter system (1999)
- assisted with the initial checkout and calibration of a new dosimeter developed to monitor radiation exposure during space flight
- conducted the calibration experiments at Texas A&M University's scattering chamber, and performed preliminary analysis of the data. (2000)

**Space Radiation Health, Dr. Donald Robbins, Consultant (08/01/97 – 09/30/01)**

- completed a comprehensive critical review of the existing literature on radiation measurements in space to serve as a baseline for shielding requirements for International Space Station. (1997)
- compiled and analyzed all US and Russian radiation measurements made on Mir. Since the ISS will fly in the same orbit used for Mir, this data should improve estimates of ISS radiation exposures. (1998)
- participated in calibration runs for flight dosimeters and serves on the ISS Multilateral Radiation Health Group to develop, with ISS partners, policies for common radiation exposure limits. (1998)
- wrote a section on neutron measurements made on the Mir station and collaborated on a comprehensive paper on Mir radiation measurements. (1999 and 2000)
- reviewed research articles, "Space Radiation Absorbed Dose Distribution in a Human Phantom," "Radiation Measurements at the International Space Station Orbits," and "Comparison of Graphite, Aluminum, and TransHab Shielding Material Characteristics in a High-Energy Neutron Field" prior to their publication in 2001.

**Technology Development, Dr. Stanley J. Kleis, Consultant (05/15/01 – 09/30/01)**

- provided predictions of the hydrodynamic environment experienced by cell assemblages cultured in the Hydrodynamic Focusing Bioreactor (HFB) when operated in both microgravity and on Earth in order to provide a basis for comparison with similar results from previous studies on other JSC bioreactor systems.

**Technology Development, Mr. James S. Moore, Consultant (01/05/98 – 07/31/98)**

- reported on the Treadmill with Vibration Isolation System (TVIS) project in consultation with the Medical Sciences Chief Engineer for the International Space Station.

**Technology Development, Mr. Rob Peterson, P.E., Consultant (10/01/95 – 07/30/01)**

- designed, tested, and built hardware using a virtual instrumentation approach to measure physiological systems for Neurolab and the International Space Station. (1996)
- designed, tested, and built microneurography flight hardware, HRF rack cooling, and a urine monitoring system for Neurolab and the International Space Station. (1997)
- continues his studies of radiation effects on the ISS Human Research Facility ultrasound system, and testing of the HRF “common fan” system, as well as research on vapor compression, a Mars Lander 2001 science equipment package, and sensor prototypes. (1998)
- continued his work on the Mars Lander 2001 science experiment package and sensor prototypes. (1999)
- developed a Health/Radiation web site and interface with the NSBRI. At the site, he has included ISS radiation experiments, measurements, and operational hardware. (2000)
- researched and tested neutron and charged particle counters/detectors, concluding that detection of ambient neutron flux is not feasible with “modest” equipment. (2001)
- periodically updated the NSBRI radiation web site. (2001)

## **Educational Programs**

USRA has a long-standing interest in promoting life sciences education, from the primary to university levels. Two DSLS scientists volunteered to organize and direct a summer science camp for children who attend the onsite JSC Child Care Center. The summer science camp has been offered for two years and judged to be an outstanding success.

As it evolved from a fellowship to an accredited residency program, the UTMB/JSC Aerospace Medicine Residency continued to receive support from the DSLS. DSLS personnel served on the Residency Faculty Committee, which meets semi-annually at CASS. Space Medicine Grand Rounds, the Residency's monthly seminar series, originated from the 185-seat CASS Lecture Hall, nominally every other month, alternating with presentations at UTMB. The JSC life sciences community was invited and encouraged to attend the intellectually stimulating presentations; the medical community received Continuing Medical Education credit from UTMB for their participation.

The Space Medicine Grand Rounds presentations were videotaped at both CASS and UTMB. The DSLS provided VHS tapes of the presentations both to the JSC Medical Sciences Division Library and to UTMB, which duplicated the tapes for distribution to the U.S. Air Force, U.S. Navy, Canadian Space Agency, European Space Agency, and Japanese Space Agency (NASDA). The DSLS also arranged for broadcast of the presentations originating from UTMB to conference rooms with video teleconference capability at JSC.

Since April 2000, the DSLS has converted videotapes of the monthly Space Medicine Grand Rounds to streaming video and posted the presentations on the DSLS web page:

<http://www.dsls.usra.edu/dsls/archive.html>

The presentations may be viewed using RealPlayer.

In 1996 and 1997 the DSLS coordinated a three-week summer residential program, the Summer Teacher Enhancement Program (STEP), for middle school teachers from the states of Colorado, Kansas, Nebraska, New Mexico, and Oklahoma. The DSLS arranged for the teachers' travel to JSC, as well as for their lodging, subsistence, and stipends. The DSLS also issued a subcontract to Biological Sciences Curriculum Studies, Dr. Don Maxwell, principal investigator, to develop curriculum for the workshops. The primary goal of the course was to integrate information and learning experiences about the history and nature of science and technology into public schools. The course used the mission of the International Space Station as a framework to integrate information about technology into the study of life sciences, technology, and social studies. Additional goals of the program were to improve the teachers' use of telecommunications to access information about science, science education, and the International Space Station. Finally, the DSLS arranged for follow-on studies of the implementation of the STEP curriculum into the teachers' classrooms.

The following tasks summarize the life sciences education research that was performed by consultants, principal investigators, and scientists during the period of performance.

**Life Sciences Education, Dr. Robert Conn, Principal Investigator  
(10/01/99 – 10/30/00)**

- produced the multi-media presentation HEROES, focusing on saving lives and preventing injuries caused by “accidents,” for the JSC Total Health and Safety Day, October 17-20, 2000. This work was performed under a subcontract with SMARTRISK.

**Life Sciences Education, Dr. Frank Crawley Consultant (10/01/95 – 09/30/96)**

- analyzed student and teacher evaluations who participated in the curriculum demonstration project utilizing the *Human Physiology in Space* text.

**Life Sciences Education, Dr. Eric Jones, Consultant (10/01/95 – 09/30/97)**

- completed interviews and analyses of the air-to-ground communications of additional Apollo lunar traverses. These are published on the Internet at the following address: <http://www.hq.nasa.gov/alsj/>

**Life Sciences Education, Barbara Lujan, Staff Scientist (10/01/95 – 09/30/97)**

- expanded the curriculum demonstration project based upon the book *Human Physiology in Space* she co-authored with Dr. Ron White.

**Life Sciences Education, Dr. Don Maxwell, Principal Investigator  
(06/01/96 – 03/31/98)**

- developed a curriculum for middle school teachers that relates the International Space Station into information and learning experiences about the history and nature of science and technology. (1996)
- presented the curriculum to 35 middle school teachers from the Midwest and from the Clear Creek Independent School District participated in the workshop during the summer of 1996.
- presented curriculum to middle school teachers from Colorado participating in the 1997 Summer Teacher Enhancement Program (STEP).
- completed site visits and a report on how the curriculum he designed for the 1997 STEP was integrated into Colorado middle school classrooms. This work was accomplished through a subcontract with Biological Sciences Curriculum Study. (1998)

**Life Sciences Education/Program Management, Dr. Gerald Taylor, Consultant  
(10/01/96 – 09/30/98)**

- assisted teachers from Omaha and Rapid City participating in the 1996 Summer Teacher Enhancement Program with their use of electronic media for communication and in the sharing and analysis of data gathered in their home school districts. (1996 and 1997)
- prepared a review of available space flight immunological data to clarify its clinical significance. (1998)

- served as managing editor for the Extended Orbiter Medical Project final report. (1998)

**Life Sciences Education, Ranganath Weiner, Principal Investigator  
(09/01/96 – 09/30/97)**

- facilitated integration of STEP curriculum into Colorado Springs classrooms. This work was performed under a subcontract with Colorado Springs School District 11.

## **Visiting and Staff Scientists**

Scientists were nominally invited for one to three years to facilitate research collaboration between academic institutions and NASA. Typically, a Visiting Scientist either filled a specific NASA research need, or had specialized expertise otherwise unavailable. Occasionally, a DSLS Visiting Scientist was engaged in a project of his/her own that complemented NASA's ongoing research. Staff Scientists were appointed for a longer time period and typically assisted with ongoing administrative tasks in addition to carrying out long-term research projects.

The following tasks, categorized by discipline, summarize the research that was performed by visiting or staff scientists during the period of performance.

### **Biomechanics, Dr. Dimitrios Kalakanis, Visiting Scientist (06/03/96 – 06/30/97)**

- developed computational models of the human body that may be analyzed using a variety of computer software.

### **Biomechanics, Dr. Patrick Riley, Visiting Scientist (09/16/96 – 12/18/96)**

- analyzed kinematic and EMG data relating to locomotor and postural control for application to issues concerning performance after space flight.

### **Biotechnology, Darlene Canales, Visiting Scientist (10/01/95 – 09/30/96)**

- tested the hypothesis that microgravity provides a unique environment to create three-dimensional models for the investigation of solid tumor invasion by human lymphocytes in vitro.

### **Biotechnology, Linda Coate-Li, Visiting Scientist (07/02/01 – 08/23/01)**

- verified and quantified preliminary work related to the effects of electromagnetic fields on living cells and tissues in current NASA bioreactors.

### **Biotechnology, David Cooper, Visiting Scientist (10/01/95 – 03/13/98)**

- studied the activation of T lymphocytes in simulated microgravity and the ability of direct protein kinase C activation and calcium stimulation to ameliorate suppressed lymphocyte activation.

### **Biotechnology, Dr. Ruwaida Haddad, Staff Scientist (12/02/96 – 09/30/01)**

- completed development of the Space Bioreactor Bioproduct Recovery System (BRS) test bed. (1997)
- evaluated and analyzed a bioproduct model, Beta-Galactosidase, and initiated investigation of a second bioproduct for use in the test bed. (1997)
- developed and optimized an Enzyme Linked Immunoassay for detecting and measuring a specific antibody. (1999)
- set up experimental designs and investigated, in collaboration with scientists from Viragen, Inc., the effect of various antigens on the induction of human interferon alpha in human lymphocytes in a microgravity environment. (2000)

- organized and directed, as a volunteer, a summer science camp for 78 children attending the onsite JSC Child Care Center. (2000)
- performed cellular viability assays to detect the cytotoxicity effect of FK506 and BHK21 cell line. (2001)
- investigated the induction of Interferon alpha by Sendai virus and microgravity; and trained and supervised a graduate student to establish a 3-D tissue culture model, design and develop encapsulation techniques of spheroids in alginate and an immunosuppressant reagent to produce an immuno-privileged site for transplantation. (2001)
- directed the Summer Camp Science Enrichment Program for children attending the onsite JSC Child Care Center. (2001)

**Biotechnology, Dr. Jacqueline Jordan, Visiting Scientist (06/05/00 – 09/30/01)**

- developed protocols for the analysis of transgenic samples with the Big Blue Assay and for the examination of transfected cell lines with radioactivity.
- developed procedures to test transgenic model alternatives.
- supervised and trained undergraduate and graduate students in general laboratory procedures, including assisting an undergraduate student to prepare and submit an abstract and award application to the Society of In Vitro Biology; the student's paper subsequently received the Cellular Toxicology Award, including a plaque and travel grant for the June 2001 meeting.
- used the NASA-developed bioreactor system for production of tissue-equivalent, in vitro models to determine if cells grown in simulated microgravity are more or less susceptible to low and high LET radiation than their 1-g control counterparts.

**Biotechnology, Cecilia Lira, Visiting Scientist (10/01/95 – 12/31/97)**

- studied the activation of T lymphocytes in simulated microgravity and the ability of direct protein kinase C activation and calcium stimulation to ameliorate suppressed lymphocyte activation.

**Biotechnology, Dr. Holly Soehnge, Visiting Scientist (08/31/98 – 12/03/99)**

- performed experiments utilizing 3-dimensional spheroids exposed to heavy ion radiation.
- grew and analyzed hybridoma cultures grown in bioreactor systems.
- investigated the genetic effects of radiation of the types encountered in long-term space missions on the cells.
- compared different media treatments meant to extend the life of the cultures.
- compared gene expression in human renal cells in simulated microgravity to controls grown in unit gravity.

**Biotechnology, Dr. Marguerite Sognier, Staff Scientist (10/01/97 – 09/30/01)**

- planned protocols, prepared and analyzed mutation assays for 3-dimensional tissue assembly samples.

- independently invented a method for creating the 3-dimensional tissue equivalent structures from human epithelial cells and rat 2 lambda fibroblasts that enables faster creation of the spheroids. (1999)
- began a study to determine if phytoestrogens can reverse microgravity-induced bone loss. (2000)
- continued to work on 3-D tissue engineering modeling of muscle cells and on a manuscript to be submitted to the *Journal of Biomechanics*. (2001)

**Biotechnology, Dr. Bruce Towe, Visiting Scientist (08/15/00 – 12/31/00)**

- developed a sensor system that supports tissue engineering in NASA bioreactors.
- conceptualized exploratory probes that interface with living bioreporter systems.
- reported on the contents and organization of new programs in advanced technologies inspired by biological systems.

**Environmental Physiology, Dr. Johnny Conkin, Visiting Scientist (05/30/96 – 09/30/97)**

- used mathematical models to assess the risk of decompression illness in astronauts during extravehicular activities by incorporating the venous gas emboli information from in-suit Doppler experiments.
- assessed the linkage between an expanding volume of gas in the tissue and the perception of pain.
- evaluated the in-suit Doppler bubble detector.
- organized a database of altitude chamber decompression data using local data, data from sister laboratories, and data from the published literature.

**Environmental Physiology, Dr. Philip Foster, Visiting Scientist (02/01-96 – 09/30/97)**

- used mathematical models to assess the risk of decompression illness in astronauts during extravehicular activities by incorporating the venous gas emboli information from in-suit Doppler experiments.
- assessed the linkage between an expanding volume of gas in the tissue and the perception of pain.
- evaluated the in-suit Doppler bubble detector.
- organized a database of altitude chamber decompression data using local data, data from sister laboratories, and data from the published literature.

**Environmental Physiology, Dr. Jitendra Joshi, Staff Scientist (01/16/01 – 09/30/01)**

- provided programmatic input for both the Advanced Life Support and Advanced Environmental Monitoring and Control elements of the Advanced Human Support Technology Program.
- strategized, planned, and analyzed programmatic tasks and performed needs assessments.
- organized and coordinated workshops and working groups.
- interacted with commercial space technology centers to facilitate collaboration and integration of research in these areas.



**Exercise Physiology, Sheril S. Moore, Research Assistant (05/06/96 – 09/30/96)**

- collected and analyzed data for a study to assess blood volume, anaerobic power and capacity, and their interactions in athletes.

**Immunology/Infectious Diseases, Dr. Peter Uchakin, Visiting Scientist  
(10/01/95 – 04/15/96) (04/12/99 – 09/30/99)**

- reduced data and performed statistical analyses of data from the Humoral Immune Study performed during the Phase 1 Shuttle/Mir program.

**Microbiology, Moronda Brown, Visiting Scientist (06/03/96 – 08/30/96)**

- collected and analyzed environmental samples in support of early human testing in the closed chamber study.

**Microbiology, Pamela Fritz, Visiting Scientist (05/01/96 – 10/06/97)**

- developed and optimized three-dimensional transgenic cell culture models using the NASA-developed rotating wall vessel.

**Microbiology, Dr. Jean Krebs, Visiting Scientist (11/01/95 – 09/30/96)**

- developed analytical tests to assess oxidative damage and efficacy of dietary antioxidants.
- developed methodology to analyze biochemical assessments of nutrients.

**Microbiology, Dr. Satish Mehta, Visiting Scientist (10/01/95 – 09/30/97)**

- examined neutrophil function, the cytotoxicity of NK/LAK cells, and cytokines to investigate the effects of space flight upon the human immune response.
- examined latent virus reactivation in space and in Antarctica.

**Microbiology, Visiting Scientist Dr. Joseph Penkala, Visiting Scientist  
(04/18/97 – 09/30/97)**

- investigated the effects of microgravity on T-cell signal transduction and cell cycle control.
- analyzed the effects of microgravity on the control of cell cycle transitions in T-cells and lymphocyte or monocyte cell lines.

**Microbiology, Dr. Raymond Stowe, Visiting Scientist  
(06/16/99 – 12/31/99) (04/01/00 – 09/30/00)**

- analyzed viral shedding frequencies in saliva, urine, and blood that utilizes his extensive experience in latent virus reactivation studies and the design of polymerase chain reaction primers. (1999)
- completed statistical analysis of molecular and serological data on 71 astronauts and a manuscript incorporating the data entitled "Reactivation and Shedding of CMV in Astronauts During Space Flight." (2000)
- analyzed immunological and virological data from STS-95 for inclusion in another manuscript. (2000)

**Muscle Physiology, Dr. Mark Clarke, Staff Scientist**

**(09/19/96 – 09/30/97) (07/01/98 – 09/30/01)**

- studied the effects of altered gravitational conditions (microgravity and hypergravity) on basic properties of cellular plasma membranes. (1997)
- tested his hypothesis that exposure to a reduced gravity environment causes a reduction in plasma membrane order, to which the cell responds by increasing membrane content of ordering lipids such as cholesterol and saturated fatty acids. (1998)
- analyzed soleus and triceps muscles from hindlimb-suspended and control rats demonstrating that myofiber atrophy is paralleled by a highly significant increase in muscle membrane cholesterol content, supporting his basic research hypothesis. (1999)
- compared techniques for measuring the order parameter of membranes, and performed parabolic flight testing of a whole blood analyzer. (1999)
- refined his central hypothesis regarding the effect of microgravity exposure upon living skeletal muscle cells. (2000)
- received US Patent Number 6008009 for an in-flight cell stainer for the International Space Station; he is in the process of completing a patent application for a novel technology for liquid handling in space flight. (2000)
- used surface-enhanced laser desorption ionization-time of flight mass spectroscopy (SELDI-TOF) to identify and quantify biomarkers important for biomedical monitoring of crew members during space flight. (2001)
- developed a three-dimensional microfluidics “brick” capable of fluidic sample preparation in a microgravity environment. (2001)
- submitted a patent application for a novel technology for liquid handling, known as directional acceleration vector driven displacement of fluids, in space flight and two patent applications for a methodology for isolation and purification of single wall carbon nanotubes from unpurified raw product. (2001)

**Neuroscience, Dr. Galen Kaufman, Visiting Scientist (10/01/99 – 09/30/00)**

- Visiting scientist **Dr. Galen Kaufman** assisted Dr. William Paloski with his tested subject perception and eye responses to centrifugation for the grant “Spatial Reorientation of Sensorimotor Balance Control in Altered Gravity”
- operated the dynamic posturography platform.

**Neuroscience, Dr. Ognyan Kolev, Visiting Scientist (10/01/95 – 12/13/96)**

- used infrared video techniques to collect and record the responses of head and eye movements to stimulation of the otoliths, semicircular canals, and neck proprioceptors.
- compared pitch head movements to yaw head movements in which the otoliths are not reoriented relative to gravity.

**Neuroscience, Dr. Anil Raj, Visiting Scientist (10/01/95 – 10/31/95)**

- investigated the effects of anti-nausea medications on the human vestibular system and its response to vestibular stimulation.

**Neuroscience, Dr. K. J. Sung, Visiting Scientist (10/01/95 – 06/30/97)**

- built a video eye tracking system and a computer system that allows real-time eye image analysis.

**Neuroscience Dr. James W. Wolfe, Visiting Scientist (10/01/95 – 11/15/96)**

- served as a member of the HRF Science Working Group and as Team Leader for the Neurolab Vestibular Research Project.

**Pharmacology, Dr. Ram Nimmagudda, Visiting Scientist (03/20/96 – 09/30/97)**

- refined the technique he developed to preserve biological samples at ambient temperatures, and he is developing a single procedure for determining the amount of melatonin present in saliva, blood, and urine.

**Program Management, Richard Beatty, Visiting Scientist (10/01/95 – 01/31/97)**

- developed management plans, planned and executed conferences, and wrote reports and protocols for the Phase 1 NASA-Mir Program.

**Program Management, Dr. David Liskowsky, Visiting Scientist (05/01/98 – 09/30/96)**

- planned and developed activities in support of the Task Force on Countermeasures and the Space Physiology and Countermeasures Program.

**Program Management, Dr. Bruce Hather, Visiting Scientist (11/01/00 – 01/31/01)**

- assisted the Enterprise Scientist for the Biomedical Research and Countermeasures Program to provide peer review of applications for NASA space-based research grants.

**Program Management, Dr. Victor S. Schneider, Staff Scientist (05/01/98 – 11/30/98)**

- served as Principal Coordinating Scientist for the Biomedical Research and Countermeasures program.

**Radiation Health Research, Dr. Laurie Craise, Visiting Scientist (05/10/96 – 12/31/96)**

- assisted in studies of the oncogenic and cytogenetic effects of heavy ion particles on mouse embryonic cells, human lymphocytes, and epithelial cells conducted at Loma Linda Medical Center, Brookhaven National Laboratory, and the National Institute of Radiological Sciences at Chiba, Japan.

**Radiation Health Research, Dr. Tetsuya Kawata, Visiting Scientist (10/01/00 – 09/14/01)**

- quantified radiation risk from high-energy heavy ion particles.
- found that isochromatid breaks rejoin quickly and that ataxia telangiectasia cells exposed to gamma rays contain many more aberrations than normal human fibroblasts.

**Radiation Health Research, Dr. Walter Schimmerling, Chief Scientist  
(5/01/99 – 9/30/01)**

- served as Program Scientist for NASA's Space Radiation Health and Radiation Biology Programs
- reviewed and evaluated program performance
- participated in budget and resource allocation
- established and interacted with scientific working panels
- made scientific presentations and briefings to the U.S. and international scientific community
- prepared white papers, scientific articles, and background materials for NASA management and the radiation research community. 01

## **Enhancement of NASA/Academic Collaboration**

### **Research Facilities**

The DSLS is housed in the Center for Advanced Space Studies (CASS), 3600 Bay Area Boulevard, Houston, Texas, 77058-1113. CASS is home to the Lunar and Planetary Institute and the Space Operations Programs, as well as the DSLS. The Institutes and Divisions share a computing center, an image-processing facility, an extensive library, publishing services, and facilities for workshops and conferences. A 185-seat lecture hall is used extensively for Space Medicine Grand Rounds and other DSLS-supported seminars. CASS is represented with a home page on the World Wide Web linked to the NASA Headquarters homepage: [www.lpi.usra.edu/CASS\\_home.html](http://www.lpi.usra.edu/CASS_home.html) Internet users can log on to the DSLS home page to get on-line information about upcoming meetings at: [www.dsls.usra.edu/dsls/meetings/meetings.html](http://www.dsls.usra.edu/dsls/meetings/meetings.html) E-mail requests are answered at the following address: [info@dsls.usra.edu](mailto:info@dsls.usra.edu)

### **Meeting and Travel Support**

The DSLS has used its depth of experience and physical access to meeting and conference facilities to enhance and facilitate NASA's collaboration with the academic community. Meetings in support of NASA life sciences research were often held at the USRA Center for Advanced Space Studies (CASS) building. Support for these meetings, as well as those scheduled at other locations in and around JSC, across the country, or in international venues, may include issuing invitations; making travel arrangements; collecting registration fees; planning agendas; purchasing meeting supplies; arranging for exhibits and poster sessions; compiling and publishing abstract volumes, programs, and proceedings; and providing other logistical support such as computer and audiovisual support.

In a productive relationship of long standing with the Space Radiation Health Community, the DSLS arranged and coordinated the Ninth Annual Investigators' Workshop in Space Radiation Research held at Loma Linda University, Loma Linda, California, June 14-17, 1998; the Tenth Annual Investigators' Workshop in Space Radiation Research held at Brookhaven National Laboratory, Brookhaven, New York, June 13-16, 1999, and assisted with the coordination of the Eleventh Annual Investigators' Workshop in Space Radiation Research held in Arona, Italy, May 26-31, 2000. DSLS staff assisted with site selection and participated in weekly preplanning teleconferences with the Workshop organizing committee. The DSLS staff produced and mailed an invitational announcement brochure to national and international researchers and collected their abstract submissions. The staff then produced the workshop abstract and program volumes, arranged travel for attendees, arranged transportation from the conference hotel to conference site, arranged tours and special events, and coordinated all Workshop site liaison and registration activities, including audio visual requirements, catering and banquet events. The DSLS had significant coordination responsibilities for eight of these annual workshops.

The DSLS staff extensively arranged travel, both domestic and international, for visiting scientists, consultants, and honorarium recipients. The research and educational travel

program enabled visiting scientists, staff scientists, and non-governmental employees to interact with their colleagues, hear scientific presentations, present papers, attend courses and perform activities of interest to NASA.

The DSLS staff and its travel agency partner World Wide Travel made travel arrangements for all non-government participants in the 1999 Biennial Space Biomedical Investigators' Workshop (more than 180) and in the 2001 Bioastronautics Investigators' Workshop (some 214). This arrangement assured NASA of obtaining the lowest possible travel costs for these workshops.

#### Conferences and Symposia

The DSLS arranged and coordinated the 12th Man in Space Symposium, "The Future of Humans in Space," for NASA and the International Academy of Astronautics. The Symposium was held June 8-13, 1997 at the Omni Shoreham Hotel, Washington, D.C. The DSLS selected the Symposium site, produced and mailed three announcement brochures to national and international researchers, distributed abstract guidelines to potential participants and received their abstract submissions, produced a Symposium website, produced the Symposium abstract and program volumes, arranged for tours and special events, received submissions and coordinated publication of Symposium proceedings, and coordinated all Symposium site liaison and registration activities, including audio visual requirements, catering and banquet events, and transportation to an embassy reception. In addition, the DSLS arranged for videotaping of the historic "Evening with Women in Space" event that featured presentations by Canadian, French, Japanese, Russian, and U.S. women who have flown in space onboard the Shuttle and Mir. Some 400 persons from the U.S. and 22 countries attended the Symposium.

The DSLS conceived, planned, and coordinated the First Biennial Space Biomedical Investigators' Workshop, January 11-13, 1999 at the South Shore Harbour Resort and Conference Center in League City, Texas. Dr. Alfred Coats was convener of the Workshop, which afforded the first opportunity for all NASA-funded space biomedical investigators to gather to present the current status of their research. There were 196 presentations, including 11 plenary presentations, 170 research task presentations, and 15 technology development posters. The Workshop participants, representing 10 discipline areas, included intramural, extramural, NASA Specialized Center of Research and Training (NSCORT), and National Space Biomedical Research Institute (NSBRI) investigators. DSLS consultant Lauren Leveton's work with the Critical Path Plan Project, a priority-setting strategic plan to mitigate the inherent health risks to humans during lengthy space exploration class missions, helped to identify the investigators who were issued invitations. Terri Jones, workshop coordinator, led the DSLS staff in selecting the Workshop site; producing and mailing two announcement brochures; obtaining abstracts; publishing two volumes of abstracts, a program, and a proceedings; arranging a tour of NASA JSC facilities; and coordinating all site liaison and registration activities, including audiovisual requirements, transportation, and catering and banquet events. This workshop was unique in that the DSLS also coordinated, with the assistance of its travel agency vendor, all non-government employee travel for some 180 persons, assuring adherence to government travel regulations and resulting in considerable cost

savings. In addition, the DSLS maintained close lines of communication with the workshop steering committee, plenary speakers, and discipline chairs and co-chairs.

During 2000 the DSLS assisted with the coordination of two international conferences: the 13<sup>th</sup> Humans in Space Symposium on the Greek island of Santorini and the Eleventh Annual Space Radiation Health Investigators' Workshop in Arona, Italy. The DSLS served as the U. S. support liaison between the Greek logistics committee and the international organizing committee for the Humans in Space Symposium. The staff assisted with the mailing of announcements, compiled the program, corresponded with session chairs and rapporteurs, and received abstracts and papers. During the conference, the staff assisted with registration and logistical tasks. The radiation workshop in Arona was the eighth such workshop marked by considerable DSLS involvement. DSLS staff participated in weekly preplanning teleconferences with the Workshop organizing committee, arranged travel for 30 attendees, and coordinated all Workshop site liaison and registration activities, including audio visual requirements, catering and banquet events.

Using its experience in coordinating the First Biennial Space Biomedical Investigators' Workshop as a base, the DSLS also coordinated its follow-on, the January 17-19, 2001 Bioastronautics Investigators' Workshop. Dr. Alfred Coats again served as convener of the Workshop, which included investigators representing 12 different NASA life sciences disciplines from both the Advanced Human Support Technology and Biomedical Research and Countermeasures programs. There were 374 meeting attendees, 196 research task presentations, 66 poster presentations, and 8 plenary presentations. The Workshop participants included intramural, extramural, NASA Specialized Center of Research and Training (NSCORT), and National Space Biomedical Research Institute (NSBRI) investigators. Terri Jones, workshop coordinator, led the DSLS staff in selecting the Workshop site; producing and mailing announcements; obtaining abstracts and publishing an abstract volume and a program; and coordinating all site liaison and registration activities, including audiovisual requirements, transportation, and catering and banquet events. The workshop proceedings were published on CD-ROM and posted on the DSLS web page. The DSLS also coordinated, with the assistance of its travel agency vendor, all non-government employee travel for the investigators, assuring adherence to government travel regulations and resulting in considerable cost savings. In addition, the DSLS maintained close lines of communication with the workshop steering committee, plenary speakers, and discipline chairs and co-chairs.

A complete list of the meetings, workshops, conferences, and symposia coordinated during the performance period is contained in Appendix IV.

#### Seminars

Seminars have provided a productive information exchange to both the NASA life sciences community and the medical community. DSLS participation has included publicity, travel support, transportation arrangements, audio visual support, videotaping the presentation, and posting the presentation on the Internet.

A complete list of seminars, including Space Medicine Grand Rounds, presented during the performance period is contained in Appendix V.



## Significant Results: Findings, Proceedings, and Publications

The DSLS published and facilitated publications for the following workshops and symposia:

- 1995 International Workshop on Cardiovascular Research in Space. The workshop was coordinated by the DSLS, and the Proceedings were published as a supplement to Vol. 28, No. 10, October, 1996 *Medicine and Science in Sports and Exercise*, official journal of the American College of Sports Medicine. The DSLS facilitated publication by arranging for audio taping of workshop presentations and by providing those tapes to the participants to aid them with manuscript preparation.
- Workshop on Space Radiation Damage and Biodosimetry. The workshop, held September 9-10, 1996 at CASS was coordinated by the DSLS, which also produced and published an announcement brochure, an abstract volume and program, and received submissions and coordinated publications of the proceedings that were published in *Radiation Research*, Volume 148, Number 5, November 1997.
- 12<sup>th</sup> Man in Space Symposium, "The Future of Humans in Space," sponsored by NASA and the International Academy of Astronautics, June 8-13, 1997 at the Omni Shoreham Hotel, Washington, D.C. The DSLS produced and published two announcement brochures, the Symposium abstract volume and program, and received submissions and coordinated publication of the proceedings that were published in *Acta Astronautica*, Journal of the International Academy of Astronautics, Volume 42, Number 1-8, January – April 1998.
- Predictions and Measurements of Secondary Neutrons in Space, September 28-30, 1998. The DSLS coordinated the workshop that was held at CASS and produced an announcement brochure, and abstract volume, and a program, and received submissions and coordinated publication of the proceedings that were published in *Radiation Measurements*, Volume 33, Number 3, June 2001.
- Ninth Annual Radiation Workshop, Loma Linda University, Loma Linda, California, June 14-17, 1998. The DSLS produced and published an announcement brochure, and an abstract volume.
- Pillars of Biology Initiative – Biomedicine, September 14-16, 1998, League City, Texas. The DSLS compiled and published a proceedings volume.
- Space Biomedical Research Investigators' Workshop, January 11-13, 1999, League City, Texas. The DSLS produced and published two announcement brochures, published two abstract volumes, a program, and a proceedings volume.
- Tenth Annual Investigators' Workshop in Space Radiation, Brookhaven National Laboratory, Brookhaven, New York, June 13-16, 1999. The DSLS produced and published an announcement brochure, an abstract volume, a program, and a proceedings volume.
- Bioastronautics Investigators' Workshop, January 17-19, 2001, League City, Texas. The DSLS produced and published an announcement brochure, an abstract volume, and a program. The DSLS also produced a CD-ROM workshop proceedings and posted the proceedings online at the following address:  
<http://www.dsls.usra.edu/dsls/meetings/bio2001/pdf/contents.pdf>

The DSLS published three Space Life Sciences Consortium Newsletters, Fall 1995, Spring 1996, and Spring 1997 during the contracting period. These newsletters, which contained feature articles on the proposed National Space Biomedical Research Institute, NASA life sciences technology, and NASA research opportunities, were sent to some 700 life sciences researchers.

Published research performed under NCC9-41 is listed in Appendix VI.

## APPENDIX I – DSLS CONSULTANTS

Principal Investigator	Location	Discipline Area	Performance Period
Baruch Brody, Ph.D.	Houston, TX	Biomedical ethics	10/01/95 - 09/30/00
Gary Caylor	Houston, TX	Occupational health and test support	08/09/99 - 06/30/01
Frank Crawley, Ph.D.	Austin, TX	Life sciences education	10/01/95 - 09/30/96
Henry Isenberg, Ph.D.	Floral Park, NY	Microbiology	08/01/98 - 09/30/00
Eric Jones, Ph.D.	Los Alamos, NM	Human factors	10/01/95 - 09/30/97
Sylviane Kahane, Ph.D.	Winnipeg, Manitoba, Canada	Neurophysiology	01/02/96 - 09/30/96
Stanley J. Kleis, Ph.D.	Houston, TX	Technology development	(05/15/01 – 09/30/01)
Charles Layne, Ph.D.	Houston, TX	Neuromuscular physiology	08/01/97 - 09/30/00
Lauren Leveton, Ph.D.	Annandale, VA	Life sciences management	10/14/96 - 09/30/01
Richard McCluskey, M.D., Ph.D.	Tampa, FL	Medical operations	06/15/98 - 09/30/98
Vernon McDonald, Ph.D.	Houston, TX	Biomechanics	10/01/96 - 09/30/97
Saroj Mishra, Ph.D.	Houston, TX	Microbiology	03/20/00 - 09/30/00
James S. Moore	Houston, TX	Technology development	01/05/98 - 09/30/00
Robert Peterson, P.E.	Houston, TX	Biomedical engineering	10/01/95 - 07/30/00
Robert G. Richmond	Houston, TX	Radiation Physiology	07/15/99 - 01/31/00
Donald Robbins, Ph.D.	Abilene, TX	Radiation physiology	08/01/97 - 09/30/00
Gerald Taylor, Ph.D.	Dillon, CO	Life sciences education	10/01/96 - 09/30/98
Richard Van Emmerick	Leverette, MA	Biomechanics	06/01/96 – 08/31/96
David Warmflash, M.D.	Houston, TX	Medical operations	10/01/98 – 01/31/99

## APPENDIX II – DSLS SUBCONTRACTS

Principal Investigator	Contracting Organization	Discipline Area	Period of Performance
Gladys Block, Ph.D.	Block Dietary Data Systems	Nutrition	06/15/96 – 09/30/00
Leo T. Chylack, Jr., M.D.	Brigham & Women's Hospital	Space radiation health	05/01/01 – 06/30/01)
Ronald Croston, Ph.D.	Ron Croston and Associates	Payload data management	10/01/95 – 11/30/96
Donal Day, Ph.D.	Louisiana State University	Environmental health	03/01/98 – 09/30/00
Andrea Dietrich, Ph.D.	Virginia Polytechnic Institute and State University	Environmental Health	01/01/96 – 02/15/97
Edward Hillman, M.D.	Baylor College of Medicine	Neuroscience	01/01/96 – 06/30/96
John Hoyer, M.D.	Children's Hospital of Philadelphia	Renal stone formation	10/01/95 – 12/31/95
Ralph Jell, Ph.D.	University of Manitoba	Linear and angular acceleration	01/01/96 – 09/30/96
J. Lawrence Katz, Ph.D.	Case Western Reserve University	Bone and muscle physiology	12/01/95 – 12/31/96
Donald Maxwell, Ph.D.	Biological Sciences Curriculum Studies	History and nature of science and technology in education	06/01/96 – 09/30/97
Cheryl Nickerson, Ph.D.	Tulane University Medical Center	Microbiology	02/01/99 – 09/30/99
Kimberly O'Brien, Ph.D.	Johns Hopkins University	Bone and muscle physiology	11/01/96 – 09/30/99
David Pendergast, Ed.D.	State University of New York Buffalo	Life sciences data management and archival	10/01/96 – 09/30/97
Kim Prisk, Ph.D.	University of California San Diego	Biomechanics	10/01/99 – 12/31/99
Barry Pyle, Ph.D.	Montana State University	Microbiology	03/01/99 – 05/31/00
John Schreiber, M.D., M.P.H.	Case Western Reserve University	Microbiology	10/01/95 – 12/31/95
Mark Sothmann, Ph.D.	Indiana University	Exercise physiology	01/15/96 – 09/30/96
Meryl Wastney, Ph.D.	Georgetown University	Biostatistics	01/02/96 – 09/30/98
Meryl Wastney, Ph.D.	Georgetown University	Biostatistics	01/01/01 – 09/30/01

<b>Principal Investigator</b>	<b>Contracting Organization</b>	<b>Discipline Area</b>	<b>Period of Performance</b>
Ranganath Weiner	Colorado Springs School District 11	Life sciences education	09/01/96 – 09/30/97
Jack Wilmore, Ph.D.	University of Texas Austin	Exercise physiology	01/15/96 – 06/30/97

### APPENDIX III – DSLS VISITING/STAFF SCIENTISTS

Name	Discipline	Period of Performance
Richard Beatty	Mission Planning/ Program Architecture	03/25/94 – 01/31/97
Maronda Brown	Microbiology	06/03/96 – 08/30/96
Darlene Canales	Environmental Science	10/01/95 – 09/30/96
Mark Clarke, Ph.D.	Biomechanics	09/19/96 – 09/30/97
Mark Clarke, Ph.D.	Biomechanics	07/01/98 – 09/30/01
Linda Coate-Li, Ph.D.	Biotechnology	07/02/01 – 09/30/01
Johnny Conkin, Ph.D.	Environmental Physiology	05/30/96 – 09/30/97
David Cooper	Biotechnology/Immunology	09/01/94 – 03/13/98
Laurie Craise, Ph.D.	Molecular biology and Microbiology	05/10/96 – 12/31/96
Philip Foster, M.D.	Environmental Physiology	02/01/96 – 09/30/97
Pamela Fritz, Ph.D.	Microbiology	05/01/96 – 10/06/97
Ruwaida Haddad, Ph.D.	Biochemistry	12/02/96 – 09/30/01
Bruce Hather, Ph.D.	Project Management and Peer review	11/01/00 – 01/31/01
Jacqueline Jordan, Ph.D.	Biotechnology	06/05/00 – 09/30/01
Jitendra Joshi, Ph.D.	Advanced Life Support	01/16/01 – 09/30/01
Dimitrios Kalakanis, Ph.D.	Biomechanics	06/03/96 – 06/30/97
Tetsuya Kawata, Ph.D.	Radiation	10/01/00 – 09/14/01
Galen Kaufman, Ph.D.	Neurophysiology	10/01/99 – 09/30/00
Ognyan Kolev, Ph.D.	Neuroscience	11/01/95 – 12/13/96
Jean Krebs, Ph.D.	Molecular Biology	11/01/95 – 09/30/96
Cecilia Lira	Biology/Immunology	09/01/94 – 12/31/97
David Liskowsky, Ph.D.	Neuroscience/Administration	10/01/95 – 09/30/96
Barbara Lujan	Life Sciences Education	03/16/87 – 09/30/97
Satish Mehta, Ph.D.	Microbiology	09/01/95 – 09/30/97
Saroj K. Mishra, Ph.D.	Microbiology	01/20/98 – 10/31/99
Sheril Moore	Exercise Physiology	05/06/96 – 09/30/96
Ram Nimmagudda, Ph.D.	Pharmacology	03/20/96 – 09/30/97
Joseph Penkala, Ph.D.	Microbiology	04/18/97 – 09/30/97
Anil Raj, Ph.D.	Neurophysiology	10/01/95 – 10/31/95
Patrick Riley, Ph.D.	Biomechanics	09/16/96 – 12/18/96
Donald Robbins, Ph.D.	Radiation Physiology	05/06/96 – 05/31/97
Walter Schimmerling, Ph.D.	Radiation Physiology	05/01/99 – 09/30/01
Victor Schneider, M.D.	Biomedicine/Life Sciences Management	05/01/98 – 11/30/98
Holly Soehnge, Ph.D.	Biotechnology	08/31/98 – 12/03/99
Marguerite Sognier, Ph.D.	Biotechnology	10/01/97 – 09/30/01
Raymond Stowe, Ph.D.	Microbiology	06/16/99 – 12/31/99
Raymond Stowe, Ph.D.	Microbiology	04/01/00 – 09/30/00

<b>Name</b>	<b>Discipline</b>	<b>Period of Performance</b>
K. J. Sung, Ph.D.	Electrical Engineering	07/17/95 – 06/30/97
Bruce Towe, Ph.D.	Biotechnology	08/15/00 – 12/31/00
Peter Uchakin, Ph.D.	Microbiology	10/01/95 – 04/15/96
Peter Uchakin, Ph.D.	Microbiology/infectious diseases	04/12/99 – 09/30/99
James W. Wolfe, Ph.D.	Neuroscience Administration	07/01/91 – 11/15-96

## **APPENDIX IV – DSLS-COORDINATED WORKSHOPS AND MEETINGS**

### **1995**

Human Research Facility (HRF) Science Working Group Meeting, 11/28-29/95, CASS.

STS-71 Data Sharing Meeting, 10/23-24/95, CASS.

Psychology and Behavior Discipline Working Group Meeting, 12/4-5/95, CASS.

Workshop on Radiation Shielding, 12/6-8/95, CASS.

STEP Evaluation Workshop, 12/13-18/95, San Antonio, Texas.

Space Station Multinational Medical Operations, 10/18-19/95, CASS.

SMP Meeting, 10/23/95, CASS.

HRF Visiting Scientist Selection, 10/26/95, CASS.

Centrifuge Meeting, 10/26-27/95, CASS.

NASA/Thames Water Meeting, 11/7-8/95, CASS.

### **1996**

Workshop on Space Flight Validation Risk, 1/24-26/96, CASS.

Neurolab International Working Group, 2/21-23/96, CASS.

Animal Research Workshop, 3/4/96, CASS.

Human Research Facility Working Group, 3/25-26/96 and 7/30-31/96, CASS.

STEP Teacher Workshop, 6/15-7/3/96, NASA/JSC.

Bioethics Task Force, 7/20-25/96, Houston.

Countermeasures Task Working Group, 8/16/96, CASS.

Space Radiation Damage and Biodosimetry Workshop, 9/9-10/96, CASS.

Advanced Technology Workshop, 9/25-27/96, CASS.

STEP/NSTA Workshop, Phoenix, AZ, 10/15-19/96.

International Partners Workshop, 11/7-8/96, CASS.



Pre-Workshop Meeting, Workshop on Space Flight Validation Risk, 1/22/96, CASS.

National Space Biomedical Research Institute Consortium meetings, 1/17, 2/15, 5/2, 5/13-14, 6/5, 7/1, 7/17, 9/11, 10/2, 10/22, 11/7, 11/22, 12/11/96, CASS.

Space Medicine Fellowship Interviews, 3/1/96, CASS.

Space Medicine Programs, 3/12/96, CASS.

Institutional Review Board Meetings, 3/28/96 and 10/4/96, CASS.

Neurovestibular Systems, 4/9/96, CASS.

Countermeasures, 4/11-12/96, CASS.

Hyperbaric Meeting, 3/26/96, CASS.

Space Medicine Fellowship Committee Meetings, 5/1, 11/7/96, CASS.

Life Sciences Data Archive Meeting, 5/7-9/96, CASS.

Cardiovascular Integrated Product (IPT) Team Meeting, 6/6/96, CASS.

SMP IPT Meeting, 6/12-13/96, CASS.

DSLS Science Council Meeting, 6/14/96, CASS.

Vestibular Meeting, 6/24-25/96, CASS.

HRF Preliminary Design Review, 6/25-28/96, CASS.

Countermeasures, 6/26-28/96, CASS.

Space Medicine Fellowship Orientation, 7/1/96, CASS.

Pre-IRB Planning Meeting, 7/8/96, CASS.

Infectious Diseases IPT Meetings, 7/25/96, 8/15/96, 10/10/96, and 12/4/96, CASS.

Bone and Muscle IPT Meeting, 8/12/96, CASS, Teleconferences 9/20/96 and 11/1/96.

Radiation IPT Meeting, 9/11/96, CASS.

Behavior and Performance IPT Teleconference 10/24/96, Meeting 12/19, CASS.

Immunology IPT Meeting, 10/31/96, CASS.

SMP Steering Committee Meeting, 11/6/96, CASS.

Space Life Sciences Association Meeting, 11/21/96, CASS.

Nutrition and Pharmacology IPT Teleconference 11/22/96, CASS.

Behavior and Performance IPT Meeting, 12/19/96, CASS.

## **1997**

Bone and Muscle IPT, 1/21/97, CASS.

NSBRC subcommittee meetings, 1/24 and 3/5/97, CASS.

EVA Oxygen Prebreathe Workshop, 1/27-29/97, CASS.

Space and Life Sciences Directorate Workshop, 1/29-31/97, CASS.

Immunology IPT, 1/29, 1997/97, JSC.

SMP Steering Committee, 2/7/97, CASS.

Payload Integration Workshop, 2/13-14/97, CASS.

Workshop on Radiation Monitoring for Mars, 2/13-14/97, CASS.

Neuroscience IPT, 2/21/97, CASS.

Aerospace Medicine Residency Interviews, 2/27/97, CASS.

Astronaut Selection Meeting, 3/4-5/97, CASS.

Bone, Muscle, Exercise IPT, 3/17/97, JSC.

SMP Steering Committee, 4/11/97, CASS.

STEP Teacher Workshop for Clear Creek Independent School District, 6/9-24/97, NASA JSC.

Aerospace Medicine Residency Orientation, 7/7/97, CASS.

Multi-State STEP Teacher Workshop, 7/19-8/8/97, NASA JSC.

Human Research Facility Science Working Group, 7/28-29/97, CASS.

Behavior and Performance IPT, 7/30/97, Parsec II.

Workshop on Impact of Solar Energetic Particle Events (SPE), 9/8-9/11/97, CASS.

Microbiology Lab Working Group, 9/10-11/97, CASS.

Neurolab International Working Group Meeting, 9/15-17/97, CASS.

Aerospace Medicine Residency Faculty Committee, 9/23/97, CASS.

Workshop in Biology-Based Technology, 10/21-22/97, CASS.

JSC 1-M Centrifuge Meeting, 10/23-24/97, CASS.

Bioethics Task Force, 11/5/97, CASS.

International Partners Workshop, 11/12-13/97, CASS.

Bone and Muscle IPT, 11/14/97, CASS.

ISO 9000 Meeting, 11/14/97, CASS.

Life Sciences Biomedical Operations Branch Meeting, 11/21/97, CASS.

Neurological Function IPT, 11/24/97, CASS.

Aerospace Medicine Residency Interviews, 12/12/97, CASS.

## **1998**

NASA/NSBRI Life Sciences Workshop, 1/5-9/98, CASS.

Institutional Review Board Hematology Subcommittee, 1/16/98, CASS.

Aerospace Medicine Residency Faculty Committee Meeting, 1/27/98, CASS.

Aerospace Medicine Residents Meeting, 1/28/98, CASS.

Spacecraft Air Quality Instrument Panel Review Workshop, 2/3-2/5/98, CASS.

International Space Station Multilateral Radiation Health Working Group, 2/16-2/17/1998, Parsec.

Immunology Integrated Product Team (IPT), 2/20/98, JSC.

Biomedical Engineering IPT, 2/25/98, JSC.

International Space Station Partners Meeting, 3/9-3/11/98, CASS.

Advanced Life Support Strategic Planning Meeting, 3/24-3/27/98, CASS.

Neurovestibular IPT, 3/31/98, CASS.

Task Force on Conflicts of Interest, 4/1/98, CASS.

Decompression Sickness Implementation Workshop, 4/14-4/15/98, CASS.

Biomedical Engineering IPT, 4/21/1998, JSC.

Immunology Task Force Meeting, 4/27-4/28/98, NSBRI.

Aerospace Medicine Residency Faculty Committee Meeting, 4/28/98, CASS.

Lunar Mars Life Support Test Bed, 4/29/98, CASS.

Ad Hoc Committee on Animal Use and Care Meeting, 5/6/98, Washington, D.C.

Node 3 Water Recovery System Technical Interchange Meeting, 5/11-5/12/98, CASS.

Immunology IPT, 5/15/98, JSC.

Biomedical Investigators' Workshop Steering Committee Meeting, 5/18/98, CASS.

Biomedical Engineering IPT, 5/22/98, JSC.

Intramural Investigators Meeting, 5/28/98, CASS.

Advanced Life Support Meeting, 6/10-12/98, CASS.

Ninth Annual Radiation Workshop, 6/14-6/17/98, Riverside, California.

IMMWPS Preliminary Design Review, 6/18-19/98, CASS.

Immunology IPT, 6/19/98/JSC.

Life Sciences Data Archive Meeting, 6/23-6/25/98, CASS.

Aerospace Medicine Residency Lectures, 6/25, 6/30/98, CASS.

Aerospace Medicine Residency Orientation, 7/2/98, CASS.

Microbiology Laboratory Meeting, 7/7/98, CASS.

Immunology IPT, 7/17/98, CASS.

Biomedical Investigators' Workshop Steering Committee Meeting, 7/20/98, CASS.

Aerospace Medicine Residency Faculty Committee Meeting, 7/29/98, CASS.

Medical Operations Summit Meeting, 8/4-5/98, Nassau Bay Hilton.

Behavior and Performance IPT, 8/25-26/98, CASS.

AHST Facility Retreat, 8/26/98, CASS.

Ethical Review of NASA-Funded Mission-Related Research, 8/31/98, CASS.

Science and Experiment Management Retreat, 9/4/98, CASS.

SMMac Therapeutics Meeting, 9/17-18/98, CASS.

Predictions and Measurements of Secondary Neutrons in Space, 9/28-9/30/98, CASS.

American College of Sports Medicine Preplanning Meeting, 10/6/98, CASS.

SBAT Workshop, 10/8/98, CASS.

Biomedical Investigators' Workshop Steering Committee Meeting, 10/20/98, CASS.

Advanced Life Support Strategic Planning Meeting, 10/20/98, CASS.

Ad Hoc Committee on Animal Use and Care Meeting, 10/21/98, Washington, D.C.

Aerospace Medicine Residency Faculty Meeting, 10/21/98, CASS.

Advanced Life Support Experiment Planning, 10/26-27/98, CASS.

Advanced Life Support Flight Experiment Planning, 10/26-27/98, CASS.

Critical Design Review, 10/28/98, CASS.

Analysis Meeting, 10/28-29/98, CASS.

Critical Design Review, 11/13/98, CASS.

Management Retreat, 11/18/98, CASS.

Behavior and Performance IPT, 11/19/98, CASS.

Aerospace Medicine Residency Interviews, 12/11/98, CASS.

## **1999**

First Biennial Biomedical Investigators' Workshop, 1/11-13/99, South Shore Harbour Resort & Conf. Center.

Artificial Gravity Workshop, 1/14-15/99, South Shore Harbour Resort & Conf. Center.

Aerospace Medicine Residency Faculty Meeting, 1/20/99, CASS.

Life Sciences Task Force Meeting, 1/25-27/99, CASS.

Space Biomedical Investigators' Workshop Debriefing Meeting, 1/27/99, CASS.

ISS Multilateral Medical Operations Panel, 2/8-12/1999, Residence Inn.

Bioplex Workshop, 2/17-19/99, CASS.

Neurological Integrated Product Team, 2/25/99, CASS.

Annual Meeting, Texas Chapter of the American College of Sports Medicine, 2/26-27/99, University of Houston Clear Lake.

Medical Operations Workshop, 3/1-5/99, CASS.

Fulbright Scholars Meeting, 3/5/99, CASS.

CCISD Teacher Focus Workshop, 3/11-12/99, CASS.

NASA Task Force Meeting, 3/15/99, CASS.

Advanced Human Support Technology Pre-Retreat, 3/16/99, CASS.

Advanced Life Support Strategic Planning Workshop, 3/24-26/99, CASS.

Radiation Risk Assessment Workshop, 3/31-4/1/99, CASS.

Medical Sciences Retreat, 4/6/99, CASS.

Life Sciences Retreat, 4/9/99, CASS.

Aerospace Medicine Residency Faculty Meeting, 4/21/99, CASS.

International Space Station Mission Medical Operations Meeting, 5/12-14/99, CASS.

Biotechnology Group Meeting, 5/24-24/99, CASS.

Flight Crew Support Branch Meeting, 6/11/99, CASS.

Tenth Annual Investigators' Workshop in Space Radiation Research, 6/13-16/99, Brookhaven National Laboratory, Brookhaven, New York.

2-Hour Prebreathe Workshop, 6/17-18/99, CASS.

NSBRI Nutrition, Fitness, and Rehabilitation Workshop, 6/21-22/99, CASS.

Human Research Facility Workshop, 6/23-24/99, CASS.

NSBRI Smart Medical Care System Workshop, 6/29-30/99, CASS.

Advanced Life Support Retreat, 7/1/99, CASS.

Aerospace Medicine Residents Orientation, 7/2/99, CASS.

International Partners Life Sciences Flight Experiments Meeting, 7/12-14/99, CASS.

NSBRI Integrated Human Function Workshop, 7/13-14/99, Nassau Bay Hilton.

NSBRI Neurobehavioral and Psychosocial Health Workshop, 7/19-20/99, Nassau Bay Hilton.

Life Sciences Management Meeting, 7/26/99, CASS.

Advanced Human Support Technology Meeting, 8/5/99, CASS.

Flight Experiments Meeting, 8/5/99, CASS.

Bioplex Retreat, 8/11-12/99, CASS.

Patent Foramen Ovale Workshop, 8/13/99, South Shore Harbour Resort & Conf. Center.

NSBRI Gender Issues Workshop, 8/24-25/99, CASS.

Meeting on Radiation Protection for ISS, 8/31-9/1/99, NASA/JSC.

Life Sciences Data Archive Committee Meeting, 10/5-6/99, CASS.

Space Life Sciences, 10/18/99, CASS.

Baylor Risk Management Meeting, 10/19/99, CASS.

Aerospace Medicine Advisory Subcommittee, 10/20/99, CASS.

Aerospace Medicine Residency Faculty Meeting, 10/20/99, CASS.

Astronaut Rehabilitation Meeting, 10/21-22/99, CASS.

NSBRI Human Performance Workshop, 10/25-26/99, CASS.

Biomedical Research and Countermeasures Meeting, 10/25/99, CASS.

Institutional Review Board Meeting, 10/26/99, CASS.

Advanced Life Support Workshop, 10/27-29/99, CASS.

NSBRI Immunology Workshop, 11/8-9/99, CASS.

Workshop on Medical Informatics and Telemedicine for Space Flight, 11/9-10/99, Nassau Bay Hilton.

NSBRI Bone Workshop, 11/16-17/99, Nassau Bay Hilton.

NSBRI Neurovestibular Workshop, 11/18-19/99, Nassau Bay Hilton.

NSBRI Muscle Workshop, 11/29-30/99, CASS.

Expedition Training Workshop, 11/30-12/1/99, CASS.

NSBRI Technology Development Workshop, 12/7-8/99, CASS.

NSBRI Radiation Workshop, 12/9-10/99, CASS.

National Council on Radiation Protection Review of NASA Radiation Operations and Protection Methods, 12/9-10/99, CASS.

Aerospace Medicine Residency Interviews, 12/10/99, CASS.

Space and Life Sciences Directorate Retreat, 12/13/99, CASS.

NSBRI Cardiovascular Workshop, 12/14-15/99, CASS.

Acoustics Bioeffects Working Group, 12/20/99, NASA/JSC.



## **2000**

SLSD Retreat, 1/5-6/00, CASS.

Neurovestibular IPT, 1/19/00, CASS.

ISS UMS Meeting, 1/21/00, CASS.

Bioastronautics Investigators' Workshop Steering Committee Meetings, 1/27/00, 4/14/00, CASS.

LSRL Branch Retreat, 2/3/00, CASS.

ISS UMS Retreat, 2/3/00, CASS.

NASA/UTMB/UTHSC Meeting, 2/4/00, CASS.

Advanced Human Support Technology Workshop, 2/7/00, CASS.

13<sup>th</sup> Humans in Space Planning Meeting, 2/8/00, CASS.

HRF Project Review, 2/9/00, CASS.

SLSD Flight Experiments Workshop, 2/9-11/00, CASS.

Cardiovascular Lab HRF Meeting, 2/11/00, CASS.

Bone/Muscle Exercise IPT, 3/6-10/00, JSC.

ISS Shielding Approach Meeting, 3/27-28/00, CASS.

NASA Ethics NBAC Review Workshop, 3/30-31/00, CASS.

Artificial Gravity Workshop, 4/4-5/00, CASS.

Neurovestibular IPT, 4/6/00, CASS.

Space Life Sciences Directorate Meeting, 4/11/00, CASS.

Aerospace Medicine Residency Faculty Meeting, 4/19/00, CASS.

Bioastronautics Retreat, 5/5/00, CASS.

Critical Path Meeting, 5/8/00, CASS.

ISS MMOP, 5/10-12/00, CASS.

LSAS/LMSAAC Meeting, 5/17-19/00, CASS.

13<sup>th</sup> Humans in Space Symposium, 5/20-26/00, Santorini, Greece.

Eleventh Annual Investigators' Workshop in Space Radiation, 5/26-31/00, Arona, Italy.

Human Machines Symbiosis Technologies Workshop, 5/30-31/00, Washington, D.C.

Bone and Mineral IPT, 6/8/00, JSC.

NSBRI Multicultural Workshop, 6/13-15/00, CASS.

UTMB/UTHSC Meeting, 6/30/00, CASS.

Bioastronautics Workshop Steering Committee Meeting, 7/12/00, CASS.

BME IPT, 7/12/00, JSC.

Neurophysiology IPT, 8/10/00, JSC.

Critical Path Workshop, 8/30/00, CASS.

Bioastronautics Workshop Steering Committee Meeting, 9/22/00, CASS.

Behavior IPT, 9/13/00, JSC.

Astronaut Rehabilitation Workshop, 9/14-15/00, CASS.

Bioplex Retreat, 10/2-3/00, CASS.

BME IPT, 10/10/00, JSC.

Bioastronautics Workshop Steering Committee Meeting, 10/16/00, CASS.

International Partners Behavior and Performance IPT, 10/16-20/00, CASS.

MMOP Radiation Health Working Group Meeting, 11/8-9/00, CASS.

Advanced Life Support ISS Meeting, 11/9/00, CASS.

NASA/UTMB Aerospace Medicine Residency Faculty Meeting, 11/8/00, CASS.

Radiation Risk workshop, 11/12-15/00, Nassau Bay Hilton and CASS.

Air Quality Instrumentation Workshop, 11/16-17, CASS.

Loma Linda Neuroscience Radiation Workshop, 12/5-7/00, CASS.

Bioastronautics Learning Laboratory, 12/6-8/00, CASS.

NASA/UTMB Aerospace Medicine Residency Interviews, 12/8/00, CASS.  
USUHS PFO Review meeting, 12/9-11/00, Nassau Bay Hilton.

NASA DSMB Meeting, 12/11/00, CASS.

Phase 5 Prebreathe Test Readiness Meeting, 12/11-13/00, CASS.

## **2001**

SD Branch Meeting, 1/05/01, CASS.

Critical Path Meeting, 1/16/01, Galveston.

Bioastronautics Investigators' Workshop, 1/17-19/01, Galveston.

International Partners' Meeting, 1/22-23/01, CASS.

Nutrition Working Group Meeting, 1/29-31/01, CASS.

Life Sciences Data Archive Meeting, 2/2/01, CASS.

BME IPT, 2/7/01, JSC.

NASA HACO Meeting, 2/12/01, CASS.

DSLS Science Council Meeting, 2/13/01, CASS.

Biotechnology Meeting, 2/21/01, CASS.

BME IPT, 2/21/01, JSC.

Bioastronautics Management Retreat/Code U Partners Meeting, 2/21-23/01, NASA Clear Lake Hilton.

Neuro IPT, 2/22-23/01, JSC.

Bioastronautics Steering Committee Meeting, 3/1/01, CASS.

BME IPT, 3/9/01, JSC.

Cardiovascular IPT, 3/12/01, JSC.

Integrated ISS Payload Planning Meeting, 4/2/01, CASS.

Space Medicine Learning Lab Retreat, 4/3-4/01, CASS.

IPT Therapeutic and Clinical Care, 4/5-6/01, CASS.

BME IPT, 4/11/01, JSC.

Behavior IPT, 4/13/01, Parsec II.

UTMB/JSC Aerospace Medicine Faculty Meeting, 4/18/01, CASS.

BME IPT, 4/25/01, JSC.

NASA/Luminex Meeting, 5/8/01, CASS.

Radiation IPT, 5/10/01, CASS.

BME IPT, 5/16 and 30/01, Parsec II.

Texas Space Grant Consortium Spring Meeting, 5/17-18/01, CASS.

Behavior IPT, 5/31/01, Parsec II.

Second International Conference on Low Level Laser Light and Photobiology  
Therapeutics, 5/31-6/1/01, CASS.

Behavior IPT, 6/11/01, Parsec II.

Habitability and Environmental Factors Retreat, 6/12-13/01, CASS.

ALS Strategic Planning Meeting, 6/13-15/01, CASS.

Flight Surgeons Retreat, 6/18-20/01, CASS.

BME IPT, 6/20/01, CASS.

Junior High Development Program, 7/11-13/01, JSC.

BME IPT, 7/18/01, JSC.

Behavior IPT, 7/23/01, Parsec II.

BME IPT, 8/15/01, JSC.

Cross Cultural Training for Flight Surgeons, 8/16/01, CASS.

Behavior IPT, 8/20/01, Parsec II.

Annual WRS Meeting, 8/21/01, CASS.

Space Medicine Workshop #2, 8/27-29/01, CASS.

International Partners Meeting, 8/29/01, CASS.

Life Sciences Retreat, 9/6/01, CASS.

Radiation IPT, 9/6/01, Teleconference.

BME IPT, 9/12/01, JSC.

Life Sciences Retreat, 9/17/01, CASS.

Flight Surgeons/USAF Training Meeting, 9/17-21/01, CASS.

BME IPT, 9/25/01, JSC.

## **APPENDIX V – DSLS-COORDINATED SEMINARS AND SPACE MEDICINE GRAND ROUNDS**

### **SEMINARS**

#### *Space Analogue Studies on Psychology in Antarctica*

Desmond J. Lugg, M.D., Australian Antarctic Division

Joanna Wood, Ph.D., KRUG Life Sciences, 11/1/95, CASS

#### *Computer Bubble Models as Tools for Understanding Decompression Sickness*

Dr. Van Liew, 1/10/96, CASS

#### *Human Movement and Coordination*

Mario LaFortune, Ph.D., USRA Visiting Scientist, 3/1/96, NASA/JSC

#### *Multiple Sensors, Multiple Joints: The Problem of Sensorimotor Integration and Control of Human Balance*

Arthur Kuo, Ph.D., 4/11/96, NASA/JSC

#### *Phase 1A Mission Science Poster Session*

Peggy Whitson, Ph.D., Mission Scientist, 2/7/96, CASS

#### *Neurolab International Working Group Poster Display*

2/20/96, CASS

#### *Phase 1A Mission Science Poster Session*

AIAA Conference, 3/5-7/96, Sheraton Astrodome, Houston

#### *New Data and Speculation on What Happens to Hearts in Space*

George Pantalos, Ph.D., 3/10/97, NASA/JSC

University of Utah

#### *Vestibular Influences on Control of Circulation and Respiration: Potential Implications for Space and Terrestrial Medicine*

Bill Yates, Ph.D., 9/17/97, NASA/JSC

University of Pittsburgh Departments of Otolaryngology and Neuroscience

#### *Radiation-Induced Genomic Instability in Haemopoietic Stem Cells*

Munira Kadhim, Ph.D., January 5, 1999, CASS

MRC Radiation and Genome Stability Unit

Harwell Didcot, UK

#### *The Health Consequences of Stress Related Immune Changes*

Ronald Glaser, Ph.D., January 27, 1999, NASA JSC

Professor of Microbiology and Immunology

Gilbert & Kathryn Mitchell Chair in Medicine

Ohio State University Medical Center

*Radiation Risk Reduction by Adaptation: A Supplement to Shielding for Astronauts?*

Ronald E. J. Mitchell, Ph.D., February 25, 1999, CASS

Radiation, Biology, and Health Physics Branch, Health, Chemistry & Environment  
Division

Atomic Energy of Canada Limited

*Biodosimetry and Biomarkers in Radiation Protection*

Akhilesh Trivedi, Ph.D., February 26, 1999, CASS

Radiation, Biology, and Health Physics Branch, Health, Chemistry & Environment  
Division

Atomic Energy of Canada Limited

*Nitric Oxide: Its Role as a Cardio-Pulmonary Mediator, August 20, 1999, CASS*

*Personal Perspectives on Nitric Oxide*

Ferid Murad, M.D., Ph.D.

Chair, Integrative Biology and Pharmacology

University of Texas-Houston Medical School

Nobel Laureate in Physiology or Medicine, 1998

*Analysis of Nitric Oxide in Exhaled Breath of Asthmatics*

Jeffrey M. Drazen, M.D.

Chief, Pulmonary and Critical Care medicine

Brigham and Women's Hospital

*Nitric Oxide, Nitrosothiols and Interaction with Hemoglobin-Biological Significance*

Andrew Gow, Ph.D.

Associate Professor of Medicine

Duke University College of Medicine

*Techniques in Measuring Nitric Oxide: Is There a Correlation Between Exhaled Breath  
and Blood Levels of Nitric Oxide?*

Philip Silkoff, M.D.

Assistant Professor of Medicine

University of Colorado Health Science Center

*The Role of Nitric Oxide in Septic Shock*

Robert F. Lodato, M.D., Ph.D.

Associate Professor

University of Texas-Houston Medical School

*Target Disruption of Nitric Oxide Synthase Genes*

Paul L. Huang, M.D., Ph.D.

Associate Professor of Medicine

Massachusetts General Hospital Cardiac Unit

*Probability of Grade IV Venous Gas Bubbles in Hypobaric Decompressions:  
Application of a Cure Rate Survival Model*

Laura Thompson, Ph.D., February 14, 2001, CASS

**Space Medicine Grand Rounds**

*Surgery 2001*

Richard M. Satava, M.D., November 22, 1995, Shriners Hospital, UTMB, Galveston  
Program Manager, Advanced Biomedical Technology Office, Advanced Research  
Projects Agency

*SLS-2 Physiology Results*

David A. Wolf, M.D., January 23, 1996, CASS Lecture Hall  
NASA Astronaut

*Advanced Life Support for Missions to the Moon and Mars*

Don Henninger, Ph.D., March 12, 1996, Shriners Hospital, UTMB, Galveston  
NASA Chief Scientist, Regenerative Life Support

*An Overview of Space Life Sciences*

David Short, M.D., April 25, 1996, CASS Lecture Hall  
Director, Space and Life Sciences, Johnson Space Center

*Space Exploration: The Challenges of Human Survival*

Bernard A. Harris, Jr., M.D., F.A.C.P., July 16, 1996, Shriners Hospital, UTMB,  
Galveston  
Vice President, SPACEHAB, Inc. and Former Astronaut

*Apollo 13 The Movie: Hollywood Vs. Aerospace Medicine*

Charles A. Berry, M.D., September 24, 1996, CASS Lecture Hall  
Former NASA Director of Medical Operations

*Medical Lessons Learned from the Shuttle/Mir Flights*

Ellen S. Baker, M.D., December 4, 1996, Shriners Hospital, UTMB, Galveston  
NASA Astronaut

*A System Analysis: DNA, Population, Aging & Cancer*

Donald S. Coffey, Ph.D., January 21, 1997, CASS Lecture Hall  
Professor, Urology, Oncology, and Pharmacology and Molecular Science  
Johns Hopkins University School of Medicine

*Why Go Back to the Moon?*

Paul D. Spudis, Ph.D., March 11, 1997, UTMB, Shriners Hospital Auditorium  
Staff Scientist, Lunar and Planetary Institute



*Individual Susceptibility to Post-Spaceflight Orthostatic Intolerance:  
Contributions of Gender-Related and Microgravity-Related Factors*  
Janice M. Yelle, M.S., April 22, 1997, UTMB, Shriners Hospital Auditorium  
Head, Cardiovascular Laboratory, NASA Johnson Space Center

*Neurologic Aspects of Space Flight*  
Edward F. Good, M.D., May 28, 1997, CASS Lecture Hall  
Private Practice of Neurology, Houston

*Fear of Flying in Aviators*  
David R. Jones, M.D., June 17, 1997, UTMB, Shriners Hospital Auditorium  
Consultant, Aerospace Psychiatry

*Aerospace Medicine: The Challenge of Prevention*  
Russell B. Rayman, M.D., July 29, 1997, UTMB, Shriners Hospital Auditorium  
Executive Director, Aerospace Medical Association

*Mars Direct: Humans to the Red Planet within a Decade*  
Robert M. Zubrin, Ph.D., August 26, 1997, UTMB, Open Gates  
President, Pioneer Astronautics

*Experiences During Long Duration Space Flight*  
Valery V. Polyakov, M.D., D. Sci., September 30, 1997, UTMB, Open Gates  
Institute for Biomedical Problems, Physician, Cosmonaut, Researcher  
Long Duration Flight Record Holder

*Shuttle Escape Systems: Lessons Learned from Challenger*  
James P. Bagian, M.D., October 23, 1997, CASS Lecture Hall  
Environmental Protection Agency, Former NASA Astronaut

*Alterations in the Mechanisms of Normal Blood Pressure Regulation  
Caused by Microgravity*  
Victor A. Convertino, Ph.D., November 23, 1997, CASS Lecture Hall  
Armstrong Laboratory, Brooks Air Force Base

*Memories of Apollo*  
Charles K. Lapinta, M.D., January 27, 1998, CASS  
NASA Johnson Space Center Flight Surgeon

*The Vestibular System in Space*  
Laurence R. Young, Sc.D., March 3, 1998, CASS Lecture Hall  
Apollo Program Professor of Astronautics  
Massachusetts Institute of Technology  
Director, National Space Biomedical Research Institute

*Medical Issues for a Mars Mission*

Jeffrey R. Davis, M.D., March 24, 1998, Open Gates Telecommunications Center  
Program Director, NASA/UTMB Aerospace Medicine Residency Program  
UTMB, Galveston

*Telemedicine in Support of Remote Missions: The Antarctic Experience*

Col. Annette Sobel, M.D., M.S., April 28, 1998  
Commander, 150 Medical Squadron  
Principal Member of the Technical Staff/Biomedical Initiatives, Sandia National  
Laboratories

*Human Performance in Long-Duration Space Flight: How Much Does Behavioral  
Medicine Matter?*

Christopher F. Flynn, M.D., May 26, 1998, CASS Lecture Hall  
NASA Johnson Space Center Flight Surgeon

*Space Environmental Challenges for a Manned Mission to Mars*

Michael Stanford, Ph.D., June 23, 1998, Open Gates Telecommunications Center  
Chief of Research and Technology Development  
Center for Aerospace Medicine and Physiology  
UTMB, Galveston

*Winging It in Space: Expedition Medicine and Its Implications for Space Flight*

Howard J. Donner, M.D., July 28, 1998, CASS Lecture Hall  
Specialist in Wilderness and Altitude Medicine

*Skylab to International Space Station (ISS)*

Joseph P. Kerwin, M.D., August 25, 1998, Open Gates Telecommunications Center  
Senior Vice President  
Wyle Laboratories Life Sciences Systems and Services

*Rehabilitation after Long-Duration Space Flight*

Patrick J. McGinnis, M.D., September 29, 1998, CASS Lecture Hall  
NASA Flight Surgeon

*Military Contributions to Space Medicine*

Col. Mike Mork, M.D., M.P.H., October 27, 1998, Open Gates Telecommunications  
Center  
Director, Aerospace Medicine Residency Program  
United States Air Force School of Aerospace Medicine

*Traumatic Injury, Critical Care, and Surgical Intervention in Microgravity*

Andrew W. Kirkpatrick, M.D., FRCSC, November 24, 1998, Open Gates  
Telecommunications Center

Section of Trauma Services, Department of Surgery, Vancouver General Hospital and Health Sciences Centre

*Medical Standards for Private and Commercial Spaceflight*

Melchor Antuñano, M.D., M.S., January 26, 1999, CASS Lecture Hall  
Manager, Aeromedical Education Division, Federal Aviation Administration  
Civil Aeromedical Institute

*Extended Duration Spaceflight on Mir: Issues and Observations*

David A. Wolf, M.D., February 23, 1999, CASS Lecture Hall  
NASA Astronaut  
STS-58, STS-86, Mir 24, STS-89

*Some Aspects of Natural Aging, the 21<sup>st</sup> Century, and  
Some Hypothetical Roles for NASA*

Stanley R. Mohler, M.D., March 23, 1999, Open Gates Telecommunications Center  
Professor and Vice Chair, Department of Community Health and  
Director, Aerospace Medicine  
Wright State University

*Biomedical Aspects of Early Manned Mars Expeditions*

John B. Charles, Ph.D., April 16, 1999, Shriners Burns Institute, Auditorium, UTMB  
Mission Scientist for STS-107  
NASA Johnson Space Center

*Screening for Coronary Artery Disease*

William B. Kruyer, M.D., June 22, 1999, CASS Lecture Hall  
Chief Cardiologist  
USAF Aeromedical Consultation Service  
USAF School of Aerospace Medicine  
Brooks Air Force Base

*Ethical Issues in Space Based Research: The Perspectives of the  
NASA Bioethics Policy Task Force*

Baruch A. Brody, Ph.D., July 27, 1999, CASS Lecture Hall  
Director, Center for Medical Ethics and Health Policy  
Baylor College of Medicine

*NASA's Radiobiology Research Program for Understanding Health Risks in Space*

Francis A. Cucinotta, Ph.D., August 24, 1999, CASS Lecture Hall  
Manager, Space Radiation Health Project  
NASA Johnson Space Center

*Telemedicine Update: What's Hot, What's Not*

James S. Logan, M.D., M.S., 1999, CASS Lecture Hall  
Founding Board Member, American Telemedicine Association

Occupational Health and Test Support  
Kelsey-Seybold, NASA Johnson Space Center

*X-38: Crew Return Vehicle for the International Space Station*  
Smith L. Johnston, M.D., October 26, 1999, Open Gates Telecommunications Center  
Flight Surgeon  
NASA Johnson Space Center

*Predicting Cardiovascular Response to Short Duration Spaceflight:  
A New Look at Old Data*  
William R. Carpentier, M.D., M.S., November 23, 1999, CASS Lecture Hall  
Director, Division of Nuclear Radiology  
Scott & White Clinic/Texas A&M University Health Sciences Center

*Updates in Space Medicine*  
Arnauld Nicogossian, M.D., January 25, 2000, NASA Headquarters  
Associate Administrator  
National Aeronautics and Space Administration

*Hot Issues in Air Medical Patient Transport*  
David W. Claypool, M.D., February 29, 2000, CASS Lecture Hall  
Medical Director, Mayo MedAir  
Department of Emergency Medicine  
Mayo Clinic

*Evaluation of Cognitive Deficits in Aviation*  
Gary Kay, Ph.D., March 28, 2000, Open Gates Telecommunications Center  
Director, Clinical Neuropsychology  
Department of Neurology  
Georgetown University Medical Center

*Cortical Networks for Complex Tasks and Neural Plasticity: An fMRI Approach*  
Joy Hirsch, Ph.D., April 25, 2000, CASS Lecture hall  
Professor and Head, The Functional MRI Laboratory  
Memorial Sloan-Kettering Cancer Center

*Oxygen Requirements for Pilots of Agile Aircraft*  
Professor John Ernsting, May 23, 2000, Open Gates Telecommunications Center  
Head of Human Physiology and Aerospace Medicine  
GKT School of Biomedical Sciences  
King's College London

*Aerospace Medicine's Role in East-West Relations 1958-1999: From Behind the Iron  
Curtain to Joint Projects*  
Charles A. Berry, MD, June 27, 2000, CASS Lecture Hall  
National and International Consultant in Preventive and Aerospace Medicine

*Mechanisms Underlying Orthostatic Intolerance: What Have We Learned from Space?*

Victor A. Convertino, PhD, July 25, 2000, Open Gates Telecommunications Center  
U.S. Army Institute of Surgical Research  
Fort Sam Houston, Texas

*Ocular Aspects of the U.S. Space Program*

F. Keith Manuel, OD, August 22, 2000, CASS Lecture Hall  
Space Center Eye Associates and Space Research Consultant

*Aviation Safety and Links to Patient Safety*

James P. Bagian, MD, PE, September 27, 2000, Open Gates Telecommunications Center  
Director, National Center for Patient Safety  
Former Astronaut, STS-29 and STS-40

*Diagnostic Ultrasound Imaging in Space*

Ashot E. Sargsyan, MD, October 24, 2000, CASS Lecture Hall  
Douglas W. Hamilton, MD, PhD  
Wyle Laboratories Systems and Services

*Biological Terrorism*

Col. Glenn Mitchell, MD, November 28, 2000, Open Gates Telecommunications Center  
U.S. Army  
Fort Sam Houston, Texas  
President, Aerospace Medical Association

*The Epidemic Within: Managing Physician Stress and Burnout*

Eugene Boisaubin, MD, December 12, 2000, CASS Hess Room  
Professor, Internal Medicine-General Medicine  
University of Texas Medical Branch

*Significant Milestones in Space Flight*

Jeffrey R. Davis, M.D., January 23, 2001, CASS Lecture Hall  
Professor and Director of Preventive Medicine Residencies and Director for Health and Safety Services  
University of Texas Medical Branch  
Galveston, Texas

*The Symptomatology of Space Flight: Evaluation of the First 100 Successful Shuttle Missions*

James P. Locke, M.D., February 27, 2001, Open Gates Telecommunications Center  
Flight Surgeon  
NASA Johnson Space Center

*NASA Health Care – Evolution for Effect*

Richard S. Williams, M.D., March 27, 2001, CASS Lecture Hall

Acting Chief Health and Medical Officer  
National Aeronautics and Space Administration  
Washington, D.C.

*Managing Fatigue in Flight Ops*

Mark R. Rosekind, Ph.D., April 10, 2001, Levin Hall, UTMB  
President and Chief Scientist  
Alertness Solutions  
Cupertino, California

*Mars Medical Operations Simulation at the Haughton Crater on Devon Island*

Jeff Jones, M.D., May 1, 2001, CASS Lecture Hall  
Flight Surgeon, NASA Johnson Space Center  
Doug Butler  
Senior Project Engineer, Wyle Laboratories, Houston, Texas  
Lecture Hall, Center for Advanced Space Studies, Houston, Texas

*Cardiac Dysrhythmias: Aeromedical Implications*

William B. Kruyer, M.D., June 26, 2001, CASS Lecture Hall  
Chief Cardiologist  
USAF Aeromedical Consultation Service  
USAF School of Aerospace Medicine  
Brooks AFB, Texas

*Aeromedical Issues in Civilian Aircraft Accident Investigation*

Mitchell A. Garber, M.D., M.P.H., M.S.M.E., July 24, 2001, Levin Hall, UTMB  
Medical Officer  
National Transportation Safety Board

*Injury Reconstruction*

Thomas M. McNish, M.D., M.P.H., August 28, 2001, CASS Lecture Hall  
Principal consultant in biodynamics and injury causation  
Biodynamics Research Corporation  
San Antonio, Texas

*Medical Care at Major Crowd Events: From Shuttle Launches to Indy Car Racing*

Richard T. Jennings, M.D., September 25, 2001, Levin Hall, University of Texas Medical Branch  
Director, UTMB/JSC Aerospace Medicine Residency  
Professor of Preventive Medicine and Community Health  
University of Texas Medical Branch, Galveston, Texas

## APPENDIX VI – PUBLISHED RESEARCH (1995-2001)

1995

### Abstracts

*Schimmerling, W.*, Cucinotta, F.A., Miller, J., Shinn, J.L., and Wilson, J.W., "Space radiation protection studies on the lunar surface," Workshop on the Moon as an International Scientific Resource, XX General Assembly of the European Geophysical Society, April 5-7, 1995, Hamburg, Germany.

*Schimmerling, W.*, "Opportunities for radiation research in space," 42nd Annual Meeting of the Radiation Research Society, April 29-May 4, 1995, Nashville, TN.

Simonsen, L.C., *Schimmerling, W.*, Wilson, J.W., and Thibeault, S.A., "Prefabricated versus in-situ materials for lunar base space radiation shielding," Workshop on the Moon as an International Scientific Resource, XX General Assembly of the European Geophysical Society, April 5-7, 1995, Hamburg, Germany.

### Research Articles

*Gantenbein, R.E.* and Shin, S.Y., "A practical method for design verification of critical software systems," CrossTalk: The Journal of Defense Software Engineering, 8, 8, 23-26, 1995.

Gilbert, J.H., Suire, S.S., *Gretebeck, R.J.*, Wong, W.W., and Siconolfi, S.F., "Effect of frequency, circuit analysis and instrument on extracellular and total body resistance," Medicine and Science in Sports and Exercise, 27, 5, S672, 1995.

*Gretebeck, R.J.*, Schoeller, D.A., Gibson, E.K., and Lane, H., "Energy expenditure during antiorthostatic bed rest (simulated microgravity)," J Appl Physiol., 7, 6, 2207-2211, 1995.

*Schimmerling, W.*, Wilson, J.W., Nealy, J.E., Thibeault, S.A., Cucinotta, F.A., Shinn, J.L., Kim, M., and Kiefer, R., "Shielding against galactic cosmic rays," Adv. Space Res., 17, 2, 231-236, 1995.

Siconolfi, S.F., *Gretebeck, R.J.*, and Wong, W.W., "Assessing total body mineral, bone mineral content, and total body protein from total body water and body density," J Appl Physiol., 79, 5, 1837-1843, 1995.

Siconolfi, S.F., *Gretebeck, R.J.*, and Wong, W.W., "Validity of using body density and three estimates of body water to assess fat, fat-free mass, mineral, and protein from 3-compartment (C) models," Medicine and Science in Sports and Exercise, 27, 5, S196, 1995.

Wilson, J.A., Kim, M., *Schimmerling, W.*, Badavi, F.F., Thibeault, S.A., Cucinotta, F.A., Shinn, J.L., and Kiefer, F., "Issues in space radiation protection: galactic cosmic rays," Health Phys., 68, 1, 50-58, 1995.

### Proceedings

*Gantenbein, R.E.*, Avresky, D.R., and Shin, S.Y., "Formal testing of fault tolerance in a space-based communications system," Proc. Eighth Int. Conf. on Computer Applications in Industry and Engineering, 99-102, 1995.

Hong, J.K, and *Gantenbein, R.E.*, "A cost-effective formal validation method for embedded systems," Proc. 13th Ann. Conf. of Assoc. of Management, 153-158, 1995.

*Gantenbein, R.E.*, Roach, S., and Zimmerman, M., "Evaluating real-time fault tolerance in communications systems," Proc. 13th Ann. Conf. of Assoc. of Management, 191-196, 1995.

*Gantenbein, R.E.* and Paloski, W.H., "Object-oriented software for laboratory data acquisition and stimulus control," Proc. 1995 AIAA/NASA Life Sciences and Space Medicine Conference, 89-90, 1995.

*Gantenbein, R.E.* and Paloski, W.H., "Object-oriented software for real-time biomedical data acquisition and stimulus control," Proc. Int. Conf. on Computer Applications in Engineering and Medicine, 49-53, 1995.

*Gantenbein, R.E.* and Shin, S.Y., "Formal verification of embedded systems using a computer-aided design tool," Proc. Second ISSAT Int. Conf. on Reliability and Quality in Design, 21-25, 1995.

## 1996

### Abstracts

Bamman, M.M., *Clarke, M.S.F.*, Feedback, D.L., Powers, S.K., and Stevens, B.R.. "Myosin heavy chain distribution following bed rest with and without resistance exercise," 1996 American College of Sports Medicine Meeting, Portland, Oregon.

*Clarke, M.S.F.* and Feedback, D.L. Mechanically-induced membrane wounding in microgravity, AIAA Meeting, Houston, Texas, March 1996.

*Clarke, M.S.F.* and Feedback, D.L. Mechanically-induced membrane wounding in microgravity, FASEB Meeting, Washington, D.C., April 1996.

*Foster, P.P.*, *Conkin, J.*, and Powell, M.R. Onset and recovery of venous gas emboli from each limb and association with hypobaric decompression illness. Undersea and Hyperbaric Medical Society Annual Scientific Meeting, 1997. (Submitted.)

Putch, L. and *Nimmagudda, R.R.* Preservation of biological fluids at ambient temperatures, J Clin Pharmacol 36:860, 1996.

### Research Articles

Badhwar, GD and *Robbins, D.E.*, "Decay rate of the second radiation belt," Adv. Space Res. 17, 151-158, 1996.

*Clarke, M.S.F.* and Feedback, D.L., "Mechanical load induces sarcoplasmic wounding and FGF release in differentiated human skeletal muscle cells," The FASEB Journal, 10, 502-509, 1996.

*Conkin J.*, Kumar, K.V., Powell, M.R., *Foster, P.P.*, and Waligora, J.M., "A probabilistic model of hypobaric decompression sickness based on 66 chamber tests," Aviat Space Environ Med 67:176-183, 1996.

*Conkin, J.*, *Foster, P.P.*, Powell, M.R., and Waligora, J.M., "Relationship of the time course of venous gas bubbles to altitude decompression illness," Undersea Hyperbaric Med 23:141-149, 1996.



McDonald, P.V., Basdogan, C., Bloomberg, J.J., and Layne, C.S., "Lower limb kinematics during treadmill walking after space flight: implications for gaze stabilization," Exp Brain Res., 112, 325-334, 1996.

Smith, S.M., Wastney, M.E., Nyquist, L.E., Shih, C.Y., Wiesmann, H., Nillen, J.L., and Lane, H.W., "Calcium kinetics with microgram stable isotope doses and saliva sampling," J Mass Spectrom., 11, 1265-1270, 1996.

Van Liew, H.D., Burkard, M.E., and Conkin, J., "Testing of hypotheses about altitude decompression sickness by statistical analyses," Undersea Hyperb Med 4, 225-233, 1996.

#### Books or Chapters in Books

Robbins, D.E., V Petrov, W Schimmerling, and IB Ushakov: Risks to humans from ionizing space radiation. In: *Space Biology and Medicine*, Volume IV: Humans in Spaceflight, Chapter 17. (In press).

#### Proceedings

Conkin, J, Kumar, K.V., Powell, M.R., Foster, P.P., Waligora, J.M. Information about venous gas emboli improves predictions of hypobaric decompression sickness. Proceedings of the 1996 Aerospace Medical Association Meeting, Atlanta, GA, Abstract No. 8, pp. A2, May 5-9, 1996.

Conkin, J, Kumar, K.V., Powell, M.R., Waligora, J.M. Characterization of venous gas emboli in the pulmonary artery of humans after hypobaric decompressions. 1996 Undersea and Hyperbaric Medical Society Annual Scientific Meeting, Anchorage, Alaska, Abstract No. 36, p. 28, May 1-5, 1996.

Foster, P.P., Shiau, L.J., Conkin, J., Powell, M.R., Chhikara, R.S., and Waligora, J.M. Influence of decompression procedure on the metabolic gas participation to bubble formation in hypobaric exposures. Proceedings of the 1996 Aerospace Medical Association Meeting, Atlanta, GA, Abstract No. 241, p. A39, Atlanta, GA, May 5-9, 1996.

Robbins, D.E., "The space radiation environment," Proceedings of NCRP Symposium: Acceptability of Risk from Radiation - Application to Human Space Flight, National Council on Radiation Protection and Measurement, Bethesda, MD.

#### Presentations

Clarke, M.S.F. and Feedback, D.L., "Mechanically-induced membrane wounding in microgravity," American Institute of Aeronautics and Astronautics Meeting, Houston, Texas, March, 1996.

Clarke, M.S.F. and Feedback, D.L., "The effect of parabolic flight on membrane-membrane fusion events and plasma membrane resealing in human skeletal muscle cells," Gravitational Responses, FASEB Meeting, Washington D.C., April 1996.

Foster, P.P., Conkin, J., and Powell, M.R., "A model based upon nitrogen and metabolic gases tension to predict bubble occurrence in hypobaric decompression," USAF/NASA joint meeting to discuss hypobaric decompression research, Houston, Texas, July 10-11, 1996.

Sung, K.J., "Video Ocular Measurement System," Inspection Day, NASA/JSC, Houston, Texas, November 13-15, 1996.

### Submissions

Clarke, M.S.F., FJ Candal, CR Vanderburg, EW Ades, and DL Feedback. Establishment of an immortalized adult human skeletal muscle cell line (Myo5LT) capable of differentiation in tissue culture. (Submitted to Developmental Dynamics.)

## **1997**

### Abstracts

Bamman, M.M., Clarke, M.S.F., Feedback, D.L., Powers, S.K., and Stevens, B.R., "Myosin heavy chain distribution following bed rest with and without resistance exercise," ACSM Meeting, Denver, CO, 1997.

Clarke, M.S.F., Bamman, M.M., and Feedback, D.L., "Myofiber wound-mediated FGF release and muscle atrophy during bed rest," FASEB Meeting, New Orleans, LA, 1997.

Clarke, M.S.F., Bamman, M.M., and Feedback, D.L., "Myofiber wound-mediated FGF release and muscle atrophy during bed rest," 12th Man in Space Symposium, Washington, D.C., 1997.

Clarke, M.S.F. and Feedback, D.L., "Mechanically-induced membrane wounding during parabolic flight, 12th Man in Space Symposium, June, 1997, Washington, D.C.

Conkin, J., Foster, P.P., and Powell, M.R., "Evolved gas, pain, the power law, and probability of hypobaric decompression sickness," Undersea and Hyperbaric Medical Society Meeting, 1997.

Foster, P.P., Conkin, J., and Powell, M.R., "Effects of biomechanics on the occurrence and persistence of venous gas emboli from a limb and association with hypobaric decompression illness," Undersea and Hyperbaric Medical Society, Cancun, Mexico, June 1997.

Foster, P.P., Conkin, J., and Powell, M.R., "Onset and recovery of venous gas emboli from each limb to predict hypobaric decompression illness occurrence," Undersea and Hyperbaric Medical Society Annual Scientific Meeting, 1997.

### Research Articles

Layne, C.S., McDonald, P.V., and Bloomberg, J.J., "Neuromuscular activation patterns during treadmill walking after space flight," Exp Brain Res., 113, 104-116, 1997.

Loftin, K., Conkin, J., and Powell, M.R., "Modeling the effects of exercise during 100% oxygen prebreathing on the risk of hypobaric decompression sickness," Aviat Space and Environ Med., 68, 199-204, 1997.

McDonald, P.V., Bloomberg, J.J., and Layne, C.S., "A review of adaptive change in musculoskeletal impedance during space flight and associated implications for postflight head movement control," J Vestib Res., 7, 239-250, 1997.

*Nimmagudda, R.*, "A method for preserving saliva samples at ambient temperatures," Biochem Archives, 13, 171-178, 1997.

*Wei, G., Lafortune-Kahane, S., Ireland, D., and Jell, R.*, "Modification of vertical OKN and vertical OKAN asymmetry in humans during parabolic flight," J Vestib Res, 1, 21-34, 1997.

*Yang, T.C., Georgy, K.A., Craise, L.M., and Durante, M.*, "Initiation of oncogenic transformation in human mammary epithelial cells by charged particles," Radiat Oncol Investig., 5, 134-138, 1997.

#### Books or Chapters in Books

*Clarke, M.S.F. and Feedback, D.L.*, "Space flight induced changes in muscle structure and function," In: *Space Physiology and Medicine*, ed. Nicogossian, A.E., Huntoon, C.L., and Pool, S.L. (4th Edition), Lea & Feibiger. (In press).

#### Presentations

*Clarke, M.S.F.*, "Membranes, muscles, and microgravity: The 3 M's of space flight-induced atrophy?," Rice Biomechanical Institute, February, 1997, Houston, TX.

*Clarke, M.S.F.*, "Learning and memory deficits in rats following administration of the plasma membrane ordering agent Pluronic F-68 (PF-68)," Neuroscience 97, October 26-30, 1997, New Orleans, LA. (poster).

*Clarke, M.S.F. and Feedback, D.L.*, "Mechanically-induced membrane wounding during parabolic flight," Oceaneering Space Systems, December 2, 1997, Houston, TX.

*Clarke, M.S.F. and Feedback, D.L.*, "Facility proposal overview (Muscle Research Laboratory, SD-3, NASA/Johnson Space Center)," Facility Review Board, NASA/Johnson Space Center, December 12, 1997, Houston, TX.

*Hashemi, B.B., Penkala, J.E., Vens, C., and Sams, C.F.*, "Regulation of activation marker expression in T cells stimulated in Microgravity," Abstract No. 2091: Molecular Biology of the Cell, vol. 8, p. 360A. Poster presentation at ASCB, December 1997, Washington, D.C.

#### Submissions

*Bamman, M.M., Clarke, M.S.F., Talmadge, R.J., Stevens, B.R., and Feedback, D.L.*, "Myosin heavy chain gel electrophoresis and immunohistochemistry in human skeletal muscle," submitted to Biotechniques and Stain Technology.

*Clarke, M.S.F., Candal, F.J., Vanderburg, C.R., Ades, E.W., and Feedback, D.L.*, "Human myogenic cell line (Myo5LT) capable of terminal differentiation in vitro," Muscle and Nerve, (in press).

*Foster, P.P., Feiveson, A.H., Powell, M.R., and Gernhardt, M.L.*, "Predicting the probability of decompression illness for the proposed prebreathe reduction protocol in extravehicular activities," Aerospace Medical Association meeting, May 1998, Seattle, WA (accepted for presentation).

### In Preparation

Conkin, J., Gernhardt, M.L., and Powell, M.R., "EVA Simulation as one aspect of a safe decompression procedure for Space Station assembly," Undersea and Hyperbaric Medical Society Annual Scientific Meeting, 1998 (in preparation).

Foster, P.P., "Effects of biomechanics on the occurrence and persistence of venous gas emboli from a limb and association with hypobaric decompression illness," Aviation, Space, and Environmental Medicine (in preparation).

Hashemi, B.B., Penkala, J.E., and Sams, C.F., "Bead-immobilized anti-TCR induces peripheral T-cell activation responses and can overcome hypogravity-induced inhibition of G1 entry," (in preparation).

Penkala, J.E., Hashemi, B.B., Cubbage, M.C., and Sams, C.F., "Phorbol ester and ionomycin or bead-immobilized anti-TCR induce S phase entry in T cells in simulated microgravity," (in preparation).

Sams, C.F., Penkala, J.E., Janson, L.W., and Hashemi, B.B., "Inhibition of lectin activation of T-cells in simulated microgravity," (in preparation).

### **1998**

#### Research Articles

Bamman, M.M., Clarke, M.S.F., Feeback, D.L., Talmadge, R.J., Stevens, B.R., Leiberman, S.A. and Greenisen, M.C. "Impact of resistance exercise during bed rest on skeletal muscle sarcopenia and myosin isoform distribution," J. Appl. Physiol. 84,157-163, 1998.

Clarke, M.S.F., Bamman, M.M. and Feeback, D.L., "Bed rest decreases mechanically induced myofiber wounding and consequent wound-mediated FGF release," J. Appl. Physiol. 85, 593-600, 1998.

Conkin, J., Foster, P. P., and Powell, M. R., "Evolved gas, pain, the power law, and probability of hypobaric decompression sickness," Aviat. Space Environ. Med. 69:352-59, 1998.

Conkin, J., Powell, M.R., Foster, P.P., and Waligora, J.M., "Information about venous gas emboli improves prediction of hypobaric decompression sickness," Aviat. Space Environ. Med. 69:8-16, 1998.

Foster, P. P., Conkin, J., Waligora, J. M., Powell, M. R., Chhikara, R. S., "Role of metabolic gases in bubble formation during hypobaric exposures," J. Appl. Physiol. 84:1088-1095, 1998.

Merkle, L.A., Layne, C.S., Bloomberg, J.J., and Zhang, J.J., "Using factor analysis to identify neuromuscular synergies during treadmill walking," J Neurosci Methods, 82, 207-214, 1998.

Miller, J., Zeitlin, C., Heilbronn, L., Borak, T., Carter, T., Frankel, K.A. Fukumura, A., Murakami, T., Rademacher, S.E., Schimmerling, W., and Stronach, C., "Ground-based simulations of cosmic ray heavy ion interactions in spacecraft and planetary habitat shielding materials," Acta Astronom. 42:389, 1998.

Schimmerling, W., Wilson, J.W., Cucinotta, F., and Kim, M-H.Y., "Evaluation of risk from space radiation with high-energy heavy ion beams," Physica Med. XIV (Supplement 1): 29-38, 1998.

### Books or Chapters in Books

Clarke, M.S.F. and McNeil, P.L. "Syringe loading: A mechanically-based method for inserting macromolecules into cells." In: Cell Biology: A Laboratory Handbook, ed. J.E. Celis (2nd Edition), Academic Press. Volume 4. pp. 47 –54, 1998.

### Reports

Schimmerling, W., Strategic Program Plan for Space Radiation Health Research, approved by Associate Administrator, Office of Life and Microgravity Sciences and Application, NASA, October 23, 1998. National Aeronautics and Space Administration, Washington, DC.

### Presentations

Clarke, M. S. F. and Feedback, D. L. "Microgravity, muscles and membranes." Presented at Congress on Cerebral Ischemia, Vascular Dementia, Epilepsy and CNS Injury (New aspects of prevention and treatment from space and underwater explorations) 9–13 May 1998, Washington, DC.

Clarke, M. S. F. and Feedback, D. L. "The effect of mechanical unloading upon human myotube sarcolemma cholesterol content: A potential site for the initiation of muscle atrophy." Presented at NASA/JSC NSCORT Annual Program Review, Institute for Biosciences and Bioengineering, Rice University, 15 May 1998, Houston, Texas.

Clarke, M.S.F., Bamman, M. M., Caldwell, R. W., Taylor, T. A. and D. L. Feedback, "Modulation of membrane cholesterol content during muscle unloading," (poster session), FASEB '98, April 1998, Washington D.C.

Clarke, M.S.F., Stowe, R.P. and D. L. Feedback, "Modulation of cholesterol-dependent plasma membrane order after microgravity exposure," (platform session) Gravitational Responses, FASEB '98, April, 1998, San Francisco, CA.

Conkin, J., Gernhardt, M. L., and Powell, M. R. "EVA simulation as one aspect of a safe decompression procedure for Space Station assembly." 1998 Undersea and Hyperbaric Medical Society Annual Scientific Meeting, May 1998, Seattle, Washington.

Conkin, J. "A log logistic survival model applied to hypobaric decompression sickness." 1998 Undersea and Hyperbaric Medical Society Annual Scientific Meeting, May 1998, Seattle, Washington.

Foster, P.P., Feiveson, A.H., Powell, M.R., and Gernhardt, M.L., "Predicting the probability of decompression illness for the proposed prebreathe reduction protocol in extravehicular activities," Aerospace Medical Association meeting, May 1998, Seattle, WA.

Foster P.P., Feiveson, A. H., Powell, M. R., and Gernhardt, M. L., "Predicting the probability of in-flight occurrence of DCI during EVAs on the Space Station." Presented at the 1998 annual scientific meeting of the Undersea and Hyperbaric Medical Society (UHMS), May 1998, in Seattle, WA.

Jones, J.A., Riggs, P.K., Yang, T.C., Pedemonte, C.H., Clarke, M.S.F., Feedback, D.L., Szucs, S. and Au, W.W., "Assessment of ionizing space radiation-induced bioeffects and strategies to reduce cellular injury," (platform session), May 1998, ASMA

Meeting, Seattle, WA.

### Submissions

Bamman, M.M., *Clarke, M.S.F.*, Talmadge, R.J., Stevens, B.R., and Feeback, D.L., "Myosin heavy chain gel electrophoresis and immunohistochemistry in human skeletal muscle," submitted to Biotechniques and Stain Technology.

*Clarke, M.S.F.*, Candal, F.J., Vanderburg, C.R., Ades, E.W., and Feeback, D.L., "Human myogenic cell line (Myo5LT) capable of terminal differentiation in vitro," Muscle and Nerve, (in press).

*Clarke, M. S. F.*, Bamman, M. M., and Feeback, D. L. "Decreased incidence of load-induced myofiber wounding and consequent wound-mediated FGF release during bed rest," Jour. Appl. Physiol. (in press).

*Foster, P.P., Conkin, J.*, Powell, M.R., Waligora, J.M., Powell, M.R., and Chhikara, R.S., "Role of metabolic gases in bubble formation during hypobaric exposures," Jour. Appl. Physiol. (in press).

*Foster, P. P.*, Feiveson, A. H., *Conkin, J.*, Glowinski, R., and Powell, M. R. "An integrated model for formation and evolution of bubbles in tissue within the respiratory system," Jour. Appl. Physiol. (Submitted.)

Morukov, B.V., Smith, S.M., Oganov, V.S., Larina, I.M., *Wastney, M.E.*, Abrams, S.A., Nyquist, L.E., Shih, C-Y, Shackelford, L.C., and Lane, H.W. "Calcium metabolism during extended-duration space flight," Society for Gravitational Physics, Rome, Italy, 1998. (Submitted.)

Robinson, R. R., Dervay, J. P., *Conkin, J.* "An evidence-based approach for estimating decompression sickness risk in aircraft operations," Aviat. Space Environ. Med. (in peer review June, 1998.)

### In Preparation

*Foster, P.P.*, "Effects of biomechanics on the occurrence and persistence of venous gas emboli from a limb and association with hypobaric decompression illness," Aviat. Space Environ. Med.

## **1999**

### Abstracts

*Schimmerling, W.*, "Space Radiation Risk for Interplanetary Travel." 11th International Congress on Radiation Research, 18-23 July 1999. Dublin, Ireland.

*Schimmerling, W.*, Wilson, J.W., Cucinotta, F.A., and Kim, M.-H.Y., "Requirements for simulating space radiations with particle accelerators." International Workshop on Responses to Heavy Ions. July 9-10, 1999. Chiba, Japan.

Wilson, J.W., Cucinotta, F.A., *Schimmerling, W.*, and Kim, M.-H.Y., "Impact of track structure effects on shielding and dosimetry," First Biennial Space Biomedical Investigators' Workshop. January 11-13, 1999. League City, Texas.

### Research Articles

Bamman, M.M., *Clarke, M.S.F.*, Talmadge, R.J. and Feeback, D.L., "Enhanced protein electrophoresis technique for separating human skeletal muscle myosin heavy chain isoforms," Electrophoresis, 20, 466-468, 1999.

Bertocci, L.A. and *Lujan, B.F.*, "Incorporation and utilization of [3-13C]lactate and [1,2-13C]acetate by rat skeletal muscle," J Appl Physiol, 86, 2077-2089, 1999.

*Clarke, M.S.F.*, Prendergast, M.A. and Terry, A.V., "Plasma membrane ordering agent Pluronic F-68 (PF-68) reduces neurotransmitter uptake and release and produces learning and memory deficits in rats," Learning & Memory 6, 634-649, 1999.

Hillman, E.J., Bloomberg, J.J., *McDonald, P.V.*, and Cohen, H.S., "Dynamic visual acuity while walking in normals and labyrinthine-deficient patients," J Vestib Res., 9, 49-57, 1999.

*Kaufman, G.D.*, Shinder, M., and Perachio, A.A., "Correlation of Fos expression and circling asymmetry during gerbil vestibular Compensation," Brain Research Interactive, 817(1,2), 246-255, 1999.

Payne DA, Mehta SK, Tying SK, *Stowe R.P.*, and Pierson, D.L. "Incidence of Epstein-Barr virus in astronaut saliva during spaceflight," Aviat. Space Environ. Med. 70:1211-1213, 1999.

Smith, S.M., *Wastney, M.E.*, Morukov, B.V., Larina, I.M., Nyquist, L.E., Abrams, S.A., Taran, E.N., Shih, C.Y., Nillen, J.L., Davis-Street, J.E., Rice, B.L., and Lane, H.W., "Calcium metabolism before, during, and after a 3-mo spaceflight: kinetic and biochemical changes," Am J Physiol, 277(1 Pt 2), R1-10, 1999.

### Books or Chapters in Books

McNeil, P.L., *Clarke, M.S.F.*, and Miyaki, K. "Cell wound assays." In: Current Protocols in Cell Biology (J.S. Bonifacino, M. Dasso, J.B. Harford, J. Lippincott-Schwartz, and K.M. Yamada, eds.) pp. 12.4.1-12.4.15, John Wiley & Sons. New York, 1999.

### Proceedings

*Schimmerling, W.*, Wilson, J.W., Cucinotta, F.A., and Kim, M-H. "Requirements for simulating space radiations with particle accelerators." In: Risk Evaluation of Cosmic-Ray Exposure in Long-Term Manned Space Mission (K. Fujitaka, H. Majima, K. Ando, H. Yasuda, and M. Susuki, Eds., Kodansha Scientific Ltd., Tokyo, 1999), pp. 1-16, 1999. International Workshop on Responses to Heavy Ions. July 9-10, 1999. Chiba, Japan.

*Schimmerling, W.* "NASA space radiation program for interplanetary missions: challenges and opportunities." In: Symposium on Space Radiation and Interplanetary Travel. Proc. Eleventh Intern. Congress of Radiat. Res., vol 2 (M. Moriarty, C. Mothersill, C. Seymour, M. Edington, J.F. Ward, and R.J.M. Fry, Eds), Dublin, Ireland 1999, pp. 733-736.

### Presentations

Mishra, S.K., Pierson, D.L., Groves, T.O., and Isenberg, H.D. "Effect of short duration space missions on body microbiota." Poster presented at the 99<sup>th</sup> General Meeting of the American Society for Microbiology, Chicago, May 29 to June 3, 1999.

### Submissions

Nickerson, C.A., Ott, C.M., Mister, S.J., Morrow, B.J., Burns-Keliher, L., Pierson, D.L. "Effect of simulated microgravity on *Salmonella* virulence." (Submitted to *Science*, July, 1999).

### Miscellaneous

Blakely, E., Schimmerling, W., "IN MEMORIAM. Tracy Chui-hsu Yang (1938-1998)." Radiat. Res. 151:501-502, 1999.

## **2000**

### Abstracts

Wilson, J.W., Cucinotta, F.A., Kim, M.-H.Y., and Schimmerling, W., "Optimized shielding for space radiation protection," First International Workshop on Space Radiation Research and 11th Annual NASA Space Radiation Health Investigators' Workshop. Arona, Italy. May 23-June 1, 2000.

Wilson, J.W., Shinn, J.L., Tripathi, R.K., Singleterry, R.C., Cloudsley, M.S., Thibeault, S.A., Cheatwood, F.M., Schimmerling, W., Cucinotta, F.A., Badhwar, G.D., Noor, A.K., Kim, M.-H.Y., Badavi, F.F., Heinbockel, J.H., Miller, J., Zeitlin, C. and Heilbronn, L., "Issues in deep space radiation protection." 13th Humans in Space Symposium. Santorini, Greece, 20-26 May 2000.

### Research Articles

Burge, H.A., Pierson, D.L., Groves, T.O., Strawn, K.F., and Mishra, S.K., "Dynamics of airborne fungal populations in a large office building," Current Microbiology, 40(1), 10-16, 2000.

Clarke, C.H., Norfleet, A.M., Clarke, M.S.F., Watson, C.S., Cunningham, K.A., and Thomas M.L., "Peri-membrane localization of the estrogen receptor alpha protein in neuronal processes of cultured hippocampal neurons," Neuroendocrinology 71(1):34-42, 2000.

Kaufman, G.D., Shinder, M., and Perachio, A.A., "Spatiotemporal properties of perihypoglossal neurons in the gerbil," J. Neurophysiol. 83:1958, 2000.

Nickerson, C.A., Ott, C.M., Mister, S.J., Morrow, B.J., Burns-Keliher, and Pierson, D.L., "Microgravity as a novel environmental signal affecting salmonella enterica serovar typhimurium virulence," Infect Immun, 68, 3147-3152, 2000.

Prisk, G.K., Elliott, A.R., and West, J.B., "Sustained microgravity reduces the human ventilatory response to hypoxia but not to hypercapnia," J Appl Physiol., 88, 1421-1430, 2000.



### Books or Chapters in Books

Clarke, M.S.F. and Feedback, D.L. "Space flight induced changes in muscle structure and function." In: Space Physiology and Medicine ed. A.E. Nicogossian, C.L. Huntoon & S.L. Pool (4th Edition) Lea & Febiger (in press, 2000).

### Presentations

Stowe, R.P., Pierson, D.L., and Barrett, A.D.T., "Evidence for Th2 shift associated with spaceflight: Immune modulation by stress hormones," Department of Pathology Annual Conference, University of Texas Medical Branch, Galveston, TX. (May, 2000).

### Submissions

Clarke, M.S.F., Vanderburg, C.R., Bamman, M.M., Caldwell, R.W. and Feedback, D.L., "In situ localization of cholesterol in skeletal muscle using a monoclonal antibody," J. Appl. Physiol. (in press), 2000.

Jones, J.A., Riggs, P.K., Yang, T.C., Pedemonte, C.H., Clarke, M.S.F., Feedback, D.L., Szucs, S. and Au, W.W., "Assessment of ionizing space radiation-induced bioeffects and strategies to reduce cellular injury," Aviat. Space Environ. Med. (in press), 2000.

Kaufman, G.D., Wood, S., Gianna, C., Black, F.O., and Paloski, W. "Spatial orientation and balance control changes induced by altered gravito-inertial force vectors," Exp. Brain Research, (submitted), 2000.

Stowe, R.P., Pierson, D.L., Feedback D.L., and Barrett A.D.T., "Stress-induced reactivation of Epstein-Barr virus in astronauts," NeuroImmunoModulation, (in press), 2000.

### In Preparation or in Review

Clarke, M.S.F., Vanderburg, C.R. and Feedback, D.L., "The Effect of acute micro-gravity upon mechanically-induced membrane damage and membrane-membrane fusion," Journal of Applied Physiology, (in review), 2000.

Clarke, M.S.F., Vanderburg, C.R., Bamman, M.M., Caldwell, R.W. and Feedback, D.L., "Sarcoplasmic reticulum membrane cholesterol content increases during muscle unloading," Journal of Physiology London, (in review), 2000.

Purcell, I.M, Kaufman, G.D., Shinder, M., and Perachio, A.A., "Vestibular efferent neurons project to the flocculus," in preparation, 2000.

### Inventions

Clarke, M.S.F., Centrifuge Operated Slide Stainer (COSST) (US Patent # 6008009)

Clarke, M.S.F., Directional Acceleration Vector Driven Displacement of Fluids, (Preliminary Patent filed 2/00)

2001

Research Articles

Clarke, M.S.F., Vanderburg, C.R., Bamman, M.M., Caldwell, R.W. and Feedback, D.L. (2000) In situ localization of cholesterol in skeletal muscle using a monoclonal antibody. *J. Appl. Physiol.* 89: p731-741.

Clarke, M.S.F. and Feedback, D.L. (Jan, 2001) Slide-Staining System for Microgravity or Gravity. (MSC-22949) NASA Tech Briefs.

Clarke, M.S.F. and Feedback, D.L., (Aug, 2000) Improved Unidirectional Cell-Stretching Device. (MSC-22834) NASA Tech Briefs.

George, K., Wu, H., Furusawa, Y., Willingham, V., Kawata, T., and Cucinotta, F.A., "Influence of cell cycle delay on the expression of chromosome damage in metaphase after high- and low-LET radiation exposures," Int J Radiat Biol, 77:175-83, 2001.

Kawata, T., Durante, M., Furusawa, Y., George, K., Takai, N., Wu, H., and Cucinotta, F.A., "Dose responses of initial G2-chromatid breaks induced in normal human fibroblasts by heavy ions, Int J Radiat Biol, 77:165-174, 2001.

Wilson, J.W., Cucinotta, F.A., Kim, M.-H. Y., Schimmerling, W., "Optimized shielding for space radiation protection," Physica Medica (supplement 1) 17: 67-72, 2001.

Wu, H., George, K., Kawata, T., Willingham, V., and Cucinotta, F.A., "Comparison of F ratios generated from interphase and metaphase chromosome damage induced by high doses of low- and high-LET radiation, Rad Res, 155:57-62, 2001.

Books or Chapters in Books

Clarke, M.S.F. and Feedback, D.L. "Space flight induced changes in muscle structure and function." In: Space Physiology and Medicine ed. A.E. Nicogossian, C.L. Huntoon & S.L. Pool (4th Edition) Lea & Febiger (in preparation, 2001).

Clarke, M.S.F., Weinberger, S. and Clarke, C.H., "Detection of protein biomarkers during oxidative stress using Surface Enhanced Laser Desorption/Ionization-Time of Flight (SELD-TOF) Mass Spectrometry." In: Oxidative Stress and Aging: Advances in Basic Science, Diagnostics and Intervention ed. R.G. Cutler & H. Rodriguez, World Scientific Publishing Co. (in press, 2001).

Nicogossian, A.E. and Schimmerling, W. "Characteristics of the space environment." In: Space Physiology and Medicine ed. A.E. Nicogossian, C.L. Huntoon & S.L. Pool (4th Edition) Lea & Febiger (in preparation, 2001).

*Schimmerling, W.* "Some considerations about space radiation dosimetry." In: Exploring Future Research Strategies in Space Radiation Sciences. Proceedings of the 2nd International Space Workshop 2000. February 16-18, 2000. Chiba, Japan. Hideyuki J. Majima and Kazunobu Fujitaka, Eds. Iryokagakusha Co., Ltd. Tokyo, 2000.

#### Presentations

*Clarke, M.S.F.*, Nanospace2001, Galveston, TX, USA. (March, 2001) Platform presentation entitled "Technology development for liquid handling in microgravity."

*Clarke, M.S.F.*, Nanospace2001, Galveston, TX, USA. (March, 2001) Platform presentation entitled "Potential applications of SELDI TOF-MS in the microgravity environment."

*Clarke, M.S.F.*, FASEB 2001, Orlando, FL, USA. (April, 2001). Poster presentation entitled "Cholesterol-mediated modulation of skeletal muscle membrane calcium pump function during mechanical unloading."

*Clarke, M.S.F.*, International Conference on Oxidative Stress and Aging, Kahului, Hawaii. (April, 2001). Platform presentation entitled "Identification of Novel Protein Biomarkers of Oxidative Stress Using Surface Enhanced Laser Desorption and Ionization Time-of-Flight Mass Spectroscopy (SELDI TOF-MS)."

*Clarke, M.S.F.*, Center For Advanced Microfabrication and Devices (CAMD), Louisiana State University, Baton Rouge, LA (April, 2001). Seminar entitled "Development of Microfluidic Devices for Use in Microgravity."

*Kawata, T.*, George, K., Willingham, V., Wu, H., and Cucinotta, F. A., "Effects of Potentially Lethal Damage Repair on Chromosome Aberrations and Cell Killing in Normal Human Fibroblasts and Ataxia Telangiectasia Fibroblasts," Annual Meeting of Radiation Research in Puerto Rico. April 21 – April 25, 2001.

*Kawata, T.*, Durante, M., Furusawa, Y., George, K., Ito, H., Wu, H., and Cucinotta, F. A., "Heavy-ion induced chromatid breaks and repair kinetics in G2 normal human fibroblasts," DOE/NASA workshop in Washington D.C. June 27 – June 30, 2001.

#### Other Publications

*Schimmerling, W.*, "Invited preface to First Annual Report of International Space Radiation Laboratory, National Institute of Radiological Sciences, Chiba, Japan. Vol. 1 (1999-2000).

*Schimmerling, W.*, "Foreword and Conference Summary, Proc. 1st International Workshop on Space Radiation Research and 11th Annual NASA Space Radiation Health Investigators' Workshop, Arona (Italy)." May 27 / 31 , 2000 (in press, 2000).

*Schimmerling, W.*, "Chairman's summary of round table on the future of models for evaluation of risk factors." Houston, TX, 12-15 November 2000. Radiat Res Sup (submitted, 2000).

Manuscripts submitted, in review, or in press

Byerly, D.L., Feiveson, A.H., Byerly, K.A., *Sognier, M.A.*, and Squires, W.G., "A statistical model for predicting muscle performance," Journal of Biomechanics, (submitted, 2001).

*Clarke, M.S.F.*, Hammond, D.R., Vanderburg, C.R., Bamman, M.M., Caldwell, R.W. and Feedback, D.L., "Sarcoplasmic reticulum membrane cholesterol content increases during muscle unloading," J Appl Physiol (in review, 2001).

*Clarke, M.S.F.*, Vanderburg, C.R., Bamman, M.M., Caldwell, R.W. and Feedback, D.L., "Sarcoplasmic reticulum membrane cholesterol content increases during muscle unloading," Journal of Physiology London, (in review), 2000.

*Clarke, M.S.F.*, Vanderburg, C.R., Bamman, M.M., Caldwell, R.W. and Feedback, D.L., "In situ localization of cholesterol in skeletal muscle using a monoclonal antibody," J. Appl. Physiol, (in press), 2000.

*Clarke, M.S.F.*, Vanderburg, C.R. and Feedback, D.L., "The effect of acute microgravity upon mechanically-induced membrane damage and membrane-membrane fusion," J Grav Physiol, (in press, 2001).

*Clarke, M.S.F.*, Vanderburg, C.R. and Feedback, D.L., "The Effect of acute microgravity upon mechanically-induced membrane damage and membrane-membrane fusion," J. Membrane Biol., (in review), 2000.

Cucinotta, F.A., *Schimmerling, W.*, Wilson, J.W., Peterson, L.E., Badhwar, G., Saganti, P., and Dicello, J., "Space radiation cancer risks and uncertainties for Mars missions," Radiat Res Sup (submitted, 2001).

Cucinotta, F.A., *Schimmerling, W.*, Wilson, J.W., Peterson, L.E., Badhwar, G., Saganti, P., and Dicello, J., "Space radiation cancer risk projections for exploration missions: uncertainty reduction and mitigation," Radiat Res (submitted, 2001).

Jones, J.A., Riggs, P.K., Yang, T.C., Pedemonte, C.H., *Clarke, M.S.F.*, Feedback, D.L., Szucs, S. and Au, W.W., "Assessment of ionizing space radiation-induced bioeffects and strategies to reduce cellular injury," Aviat. Space Environ. Med. (in press), 2000.

*Kawata, T.*, and Durante, M., "Kinetics of chromatid break repair in G2-human fibroblasts exposed to low- and high-LET radiations." Physica medica (in press, 2001).

*Kawata, T., Durante, M., Furusawa, Y., George, K., Ito, H., Wu, H., and Cucinotta, F.A., "Rejoining of heavy-ion induced isochromatid breaks in normal human G2 fibroblasts," Radiat Res (in press, 2001).*

*Kawata, T., Durante, M., Furusawa, Y., George, K., Ito, H., Wu, H., and Cucinotta F.A., "G2-Chromosome aberrations induced by high-LET radiations," Adv Space Res (in press, 2001).*

*Nickerson, C.A., Goodwin, T.J., Terlonge, J., Ott, C. Mark, Clarke, M.S.F., Buchanan, K.L., Uicker, W.C., Emami, K., Cedor, C.L., Ramamurthy, R., Hammond, T. and Pierson, D.L., "Novel tissue assemblies: models for enteric pathogenesis," Infection and Immunity (in review, 2001).*

*Schimmerling, W., Cucinotta, F.A., and Wilson, J.W., "Radiation risk and human space exploration," Adv Space Res (in press, 2000).*

*Wilson, J.W., Shinn, J.L., Tripathi, R.K., Singleterry, R.C., Cloudsley, M.S., Thibeault, S.A., Cheatwood, F.M., Schimmerling, W., Cucinotta, F.A., Badhwar, G.D., Noor, A.K., Kim, M.-Y., Badavi, F.F., Heinbockel, J.H., Miller, J., Zeitlin, C., and Heilbronn, L., "Issues in deep space radiation protection," Acta Astronaut (in press, 2000).*

#### Inventions

*Clarke, M.S.F., Directional Acceleration Vector Driven Displacement of Fluids, (Preliminary Patent filed 2/00).*

*Clarke, M.S.F., Spatial Localization of Biologically Dispersed Single Walled Carbon Nanotubes Into Useful Structures (provisional patent application filed, 2001).*

*Clarke, M.S.F., Feeback, D.L., Nikolaev, P., and Arepalli, S., Isolation and Purification of Single Walled Carbon Nanotube Structures (provisional patent application filed, 2001).*

*Haddad, R.S., Morrison, D.R., and Vazquez, D.E., Encapsulation of 3-D Cell Constructs with Immobilized Immunosuppressant Drugs (patent application in process, 2001).*

#### Grant Applications

*DARPA Grant Application Project: "HI-MEMS Technology Development" (Clarke, M.S.F., Co-Investigator)*

*NIH-NASA RO1 Project: "Development and Validation of An In Vitro Model of Muscle Atrophy" (Clarke, M.S.F., Principal Investigator)*

NIH-NASA RO1 Project: “The effect of unloading on sarcoplasmic reticulum membrane cholesterol content and intra-myofiber calcium homeostasis” (*Clarke, M.S.F.*, Principal Investigator)